Prof M.J. Elrod,
Mont. Univers.

W.B. Harlan, President, Board of Administration

Prof. F B. Linfield,
Agr. College
Acting Secretary

Second Annual Report

OF THE

Montana Farmers' Institutes

FOR THE YEAR ENDING NOVEMBER 30

1903

AUTHORIZED BY

The Administrative Board of Farmers' Institutes

Edited by F. B. LINFIELD, Acting Secretary

"INDEPENDENT PUBLISHING COMPANY, HELENA, MONTANA."

Letter of Transmittal.

Bozeman, Mont., Nov. 1, 1903.

To His Excellency, Joseph K. Toole,
Governor of Montana:

Dear Sir—I have the honor to transmit herewith the Second Annual Report of the Montana Farmers' Institutes.

Very respectfully,

F. B. LINFIELD,
Acting Secretary.

Montana Board of Administration of Farmers' Institutes.

Gov. J. K. Toole ..... Ex-Officio
S. Fortier, Director Montana Experiment Station.... Ex-Officio
T. C. Power, President Wool Growers' Association..... Helena
J. T. Brown, President Stock Growers' Association..... Birney
W. B. Harlan, President Horticultural Society..... Como
F. L. Benepe, Pres. Registered Cattle Breeders' Asso... Bozeman
E. N. Brandigee, Pres. State Board of Horticulture..... Helena
W. M. Wooldridge, Pres. State Agricultural Society.... Hinsdale

Officers of the Board.

W. B. Harlan ..... President
*S. Fortier ..... Secretary and Superintendent

Executive Committee.

Gov. J. K. Toole ..... Helena
W. B. Harlan ..... Como
*S. Fortier ..... Bozeman

* For the later part of the year Prof. Fortier has been absent on leave and F. B. Linfield, Vice-Director of the Experiment Station has been acting secretary of the Board.

CONTENTS.

State Law Providing for Farmers' Institutes as Amended by the 8th Legislative Assembly.

Be it Enacted by the Legislative Assembly of the State of Montana:

Section 1. That Section 1 of said Act be and the same is hereby amended so as to read as follows:

Section 1. The Board of Administration of Farmers' Institutes, as provided for in this Act, shall consist as follows:

The Governor of the State and the Director of the Montana Experimental Station, both of whom shall be ex-officio members, and the presidents of the following named organizations:

The Montana Registered Cattle Breeders' Association, the Montana Woolgrowers' Association, The Montana Livestock Association, The Montana Horticultural Society, The Montana State Board of Horticulture, The Montana Agricultural Association and the Montana Dairymen's Association, when these last two shall have been duly organized. Members of such Board of Administration shall be designated the "Directors of the Montana Farmers' Institutes," and shall be authorized to hold Institutes for the instruction of the citizens of this State in the various branches of agriculture, and shall prescribe such rules and regulations as they may deem best for organizing and conducting the same. Such Institutes shall be held at least once in each county in each year and at such times and places as the directors may designate; provided, the requirements of the Board of Administration have been complied with, such as County Institutes or local organizations providing a suitable hall, lighting and heating the same, and bearing necessary advertising expense. The directors may employ an agent or agents to perform such work in organizing or conducting such Institutes as they may deem best. A course of instruction at such Institute shall be so arranged as to present to those in attendance the results of the most recent investigations in theoretical and practical agriculture.

Section 2. For the purpose mentioned in this Act, the Directors may use the sum as they deem proper, not exceeding the sum of Four Thousand Dollars ($4,000.00) per annum, and that until otherwise provided by law the State Treasurer shall pay,

out of any money in the State Treasury not otherwise appropriated, a sum not to exceed Four Thousand Dollars ($4,000.00) during each fiscal year hereafter, on the order of the said Board of Directors. Each Institute held under the authority of this Act, shall be entitled to a sum not exceeding Fifty ($50.00) Dollars from the amount appropriated under this Act.

Section 3. That Section 5 of this Act be and the same is hereby amended so as to read as follows:

Section 5. That immediately upon the passage and approval of this Act, the Board of Administration shall meet in the City of Helena and arrange for the first series of Institutes throughout the State, and thereafter such Board shall meet annually on the second Tuesday in September to arrange for such Institutes, and they shall again meet on the second Tuesday in March of each year to audit all expenditures and arrange for the printing in pamphlet form, within sixty days of said meeting, of the "Institute Annual," and that the cost of said Annual shall not exceed Thousand Five Hundred Dollars ($1,500.00) in any one year.

Section 4. That all Acts and parts of Acts in conflict with the provisions of this Act be and the same are hereby repealed.

Section 5. This Act shall take effect from and after its approval.

B. F. WHITE,
Speaker of the House of Representatives.
JAME P. MURRAY,
Pres. Pro Tem, President of the Senate.

Approved March 6th, 1903.
JOS. K. TOOLE, Governor.
Filed March 6th, 1903 at 5:45 P. M.
GEO. M. HAYS, Sec. of State.

Rules and By-Laws of the Board of Administration of Farmers' Institutes.

ARTICLE I.

The Organization of the Board of Farmers' Institutes.

Section 1. The Board of Administration of Farmers' Institutes, as provided by law (Chapter CX, Law of 1903), shall consist of the Governor of the State and the Director of the Montana Experiment Station as ex-officio members, and the Presidents of the following named organizations: The Montana Registered Cattle Breeders' Asociation, The Montana Wool Growers' Association, The Montana Live Stock Association, The Montana Horticultural Society, The Montana State Board of Horticulture, The Montana Agricultural Association and The Montana Dairymen's Association, when the latter shall have been organized.

Four members shall constitute a quorum for the transaction of business at any meeting.

Section 2. The Board shall meet in the city of Helena on the second Tuesday in March and the second Tuesday in September of each year. They shall meet at such other times as may be necessary, at the call of the President.

Section 3. The officers of the Board shall consist of a President and a Secretary, who shall be elected at the meeting held the second Tuesday in March, immediately after the adjournment of the regular session of the Legislature, and shall hold office for two years, or until such time as their successors are elected and qualify.

ARTICLE II.

Duties of the Board.

Section 1. The Board shall have general charge of the Farmers' Institute metings and shall pass upon all expenditures, and upon all plans and business matters, submitted by the President and Secretary.

Section 2. The State shall be divided into districts comprising several counties, which may be reached by a party of Institute speakers without un-necessary expense.

For the present the following districting of the State is recommended:

District 1.

1. Cascade County.

2. Teton County.
3. Flathead County.
4. Chouteau County.
5. Valley County.

District 2.

1. Missoula County.
2. Ravalli County.
3. Granite County.
4. Powell County.
5. Deer Lodge County.

District 3.

1. Lewis and Clarke County.
2. Jefferson County.
3. Silver Bow County.
4. Beaverhead County.
5. Madison County.

District 4.

1. Gallatin County.
2. Meagher County.
3. Fergus County.
4. Broadwater County.

District 5.

1. Park County.
2. Sweetgrass County.
3. Yellowstone County.
4. Rosebud County.
5. Carbon County.
6. Custer County.
7. Dawson County.

Section 3. In one or more districts, which shall be varied each year a full corps of Institute workers shall attend and hold a two or three days session in each county. This deputation shall be accompanied by a stenographer who shall make a full report of these meetings for the Farmers' Institute Annual.

Section 4. The Board shall endeavor to encourage by all means in its power, the formation of local Farmers' Institutes, or Farmers' Clubs in the various counties, or communities of the State. It shall lend such aid as is in its power towards maintaining these organizations and towards helping to make their work efficient and helpful to the communities in which they are or-

ganized. It shall also, as far as possible, recognize and use those local organizations in arranging for Institute meetings in any locality.

ARTICLE 3.

The Executive Committee.

The President of the Board, the Governor of the State and the Secretary of the Board shall constitute an Executive Committee to consider and pass upon all matters that may arise during the interim between the meetings of the Board. Before any bills are paid they must be submitted to and approved by the President and Secretary.

ARTICLE 4.

Duties of Officers.

Section 1. The President shall preside over all meetings of the Board. He shall present to the Board from time to time his views as to the requirements of the Farmers' Institute work and shall make such recommendations to the Board as he deems best.

Section 2. The Secretary shall be Superintendent of Farmers' Institutes and shall have immediate charge of and make all arrangements for the Farmers' Institute work over the State. Such plans and arrangements he shall submit for the approval of the Board.

He shall make a report of the work of the year, giving a full account of the meetings held, the attendance at each meeting, the list of speakers at the various meetings and a full list of the expenditures for the year, together with such recommendations looking toward the greater efficiency of the Farmers' Institute work as he deems best to make. The whole or a summary of this report to be embodied in the Farmers' Institute Annual. The Secretary shall perform such other duties as usually pertain to this office.

Section 3. The Secretary shall collect all the papers, addresses and discussions given at the various meetings. He shall edit the same and cause them to be printed in a pamphlet to be known as the Farmers' Institute Annual.

ARTICLE 5.

Order of Business.

At regular meetings of the Board the following order of business shall be followed:

1. Roll Call.
2. Minutes of the Last Meeting.
3. Reports of Special Committees.
4. Reports of Standing Committees.
5. Unfinished Business.
6. Reports of Officers.
7. Election of Officers.
8. Miscellaneous Business.
9. Adjournment.

ARTICLE 6.

These By-Laws can only be amended by a two-thirds vote of the full Board.

Committee:

GOV. J. K. TOOLE.
E. N. BRANDIGTE.
F. B. LINFIELD.

Approved September 14, 1903.

Secretary's Report.

The duty of arranging for the Farmers' Institute work for the past year has been in the hands of two men. For the first half of the year Director S. Fortier had immediate charge of the office of Secretary but since July 1st F. B. Linfield Vice-Director of the Experiment Station has been acting Secretary.

There being no funds available for the Institute work until after the adjournment of the Legislature, no meetings were held during the early part of the year.

The first meeting of the season was held at Dillon, Beaverhead County, on March 14th. From April 28th to May 5th meetings were held in Teton, Cascade, Chouteau and Valley counties. From June 26th to July 3d meetings were held in Missoula, Ravalli, Granite and Powell counties. On Oct. 8th and 9th a meeting was held in Lewis and Clarke County. From Nov. 10th to Dec. 4th, meetings were held in the counties of Park, Sweetgrass, Yellowstone, Carbon, Rosebud, Custer, Dawson, Gallatin, Broadwater, Madison, Jefferson, Meagher and Fergus.

It will thus be seen that during the year in practically every farming county in the state except Flathead, meetings have been held. The following list gives full details about the meetings together with a list of the speakers at each place.

County	Town or City	Date	No. of Sessions	Av. Attend.	Speakers
Beaverhead	Dillon	Mar. 14	two	50	Dr. F. W. Traphagen. Prof. F. B. Linfield.
Teton	Chouteau	Apr. 25	one	25	
Cascade	Great Falls	Apr. 27	two	50	
	Cascade	Apr. 28	two	50	Mr. W. B. Harlan.
Chouteau	Chinook	Apr. 29	two	75	Mr. W. M. Wooldridge
	Harlem	Apr. 30	one	30	Prof. M. J. Elrod.
	Malta	May 1	one	75	Prof. F. B. Linfield.
Valley	Hinsdale	May 2	one	15	
	Culbertson	May 5	two	75	
Missoula	Plains	June 26	one	75	
	Missoula	June 27	none	..	
Ravalli	Darby	June 29	one	65	
	Corvallis	June 30	one	20	Prof. M. J. Elrod.
	Victor	June 30	one	15	Prof. F. B. Linfield.
	Florence	July 1	none	..	
Granite	New Chicago	July 2	one	25	
Powell	Deer Lodge	July 3	none	..	
Park	Livingston	Nov. 20	one	..	Dr. James Reid. Mr. W. J. Elliott. Miss L. Harkins. Mrs. F. E. Marshall. John W. Pace.
Sweet Grass	Big Timber	Nov. 10	one	18	R. W. Fisher.
Yellowstone	Park City	Nov. 11	two	50	Miss L. Harkins.
	Billings	Nov. 12	one	60	F. B. Linfield.
Carbon	Red Lodge	Nov. 14	one	30	
Rosebud	Forsyth	Nov. 16	one	75	Mr. W. M. Harlan.
Custer	Miles City	Nov. 17	none	..	Miss L. Harkins.
Dawson	Glendive	Nov. 18	one	75	Prof. R. A. Cooley.
Gallatin	Bozeman	Nov. 16	one	20	
Broadwater	Townsend	Nov. 22	two	20	
Madison	Pony	Nov. 24	two	100	Prof. F. B. Linfield.
	Twin Bridges	Nov. 26	two	100	Prof. R. W. Fisher.
Jefferson	Whitehall	Nov27, 28	four	75	Pres. James Reid.
Meagher	White Sul. Springs	Dec. 1	one	60	Prof. M. J. Elrod.
Fergus	Lewistown	Dec. 4	two	200	
Lewis and Clarke	Helena	Oct. 8, 9	two	25	

The attendance may appear small, but it should be remembered that the figures given are not the total attendance at any one place of meeting but the average attendance of one to four sessions. Again many of the meetings were held in sparsely settled districts; in not a few of the places there were those who traveled 10 to 20 miles and in a few cases as far as 50 miles. Another factor that told against the attendance was that the spring meetings were close to the busy season of the year and the fall meetings unfortunately came during the coldest weather of the year and the first stormy weather of the year. The largest attendance at any one session was at Lewistown in Fergus county when over 300 were present.

It is hoped that as the work develops its scope will broaden, taking in the work of the home as well as that of the farm. The endeavor will be made to make the meetings attractive and of real value to both old and young.

An attempt has been made during the year to get the Institute work organized on a systematic basis. The State has been divided into districts, so arranged as to save expense in visiting the various counties. An attempt has also been made to get the various counties to organize a local Farmers' Institute or to name some person in the locality who would act as local representative of the board in looking after the local advertising and arrangements for the meetings. Considerable yet remains to be done on this point.

Some work has been done towards getting a list of those who would help at the Farmers' Institute meetings over the state, together with a list of the topics they are prepared to discuss. The list as far as completed is appended to this report.

In the following pages have been gathered a large number of the papers and addresses presented at the meetings of the year. In editing these papers I have presumed that each person assumed responsibility for the matter presented under his name. It was possible to destroy this individuality, but I thought rather to preserve it even though at times I might not agree with the conclusions stated. I trust the articles will be read with this thought in mind.

Financial Statement for the Year Ending Nov. 31st, 1903.

Expenses of Administration Board	$59.50
Traveling Expenses of Institute Workers	1,269.60
Illustrative Material	23.15
Express and Drayage	16.25
Typewriting and Office Work	619.50
Postage and Stationery	136.50
Printing Posters, Etc.	40.75
Second Annual Report, 5,000 copies, 500 bound in cloth	771.19
Total	$2,936.44

Acknowledgment.

Our thanks are especially due to those who have generously contributed of their time and energy in visiting various parts of the state as speakers at the various meetings. Also to those who in the various localities contributed of their time toward

advertising and arranging for the meetings or in presenting papers or music for the program, our thanks are due.

Or acknowledgments are also due to the railroads of the state for transportation of Institute workers and for free carriage of the First Annual Report to the various parts of the state for distribution.

F. B. LINFIELD,
Acting Secretary.

Farmers' Institute Lectures with Topics of Each.

Jno. W. Pace, Helena—
Livestock and the Breeding of Horses and Cattle.
Organization Among Farmers.

W. W. Wylie, Bozeman—
Alfalfa.
Clover.
Summer Fallowing and Grain Raising.
Farming and Farm Life.

E. Broox Martin, Bozeman—
Clover.
Sheep Feeding
Cattle Feeding.
Preserving and Fertility of the Soil.
Farm Tools and Their Care.

C. W. H. Heideman, Missoula—
Landscape Gardening Topics.
Horticultural Topics, Orcharding, Fruit Growing, Etc.
Nursery Topics. Propagation, etc.
Top Grafting.

W. O. Parker, Billings—
Dairying.
Thorough Cultivation Essential in Growing Crops.
Diversified Farming.

D. E. Bandmann, Missoula—
Montana as an Apple Producing State.
Planting an Orchard: Cultivation vs. Non-cultivation.
Montana as a Dairying State.
The Industry of Cider Making.
Grafting and Budding on Undesirable Trees.
The Importance of Spraying.

Mrs. F. E. Marshall, Bozeman—
Japanese Farming.
Japanese Life and Industries.
Talk on Hawaiian Life and Farming.
Art Talk with Sculptures and Pictures.
Why Do We Study Art?
Village Improvement.
The House Beautiful.
Bull Fight, with colored engravings and a few lantern slides.
Methods of Raising Corn and Wheat in Maryland and the Valley of Virginia.
Pot au foi and French Student Cooking.
Episodes of Travel in Different Countries.

John M. Robinson, Bozeman—
Sheep Feeding in Gallatin Valley.
The Growing of Clover and Alfalfa.
Cultivation of the Soil vs. Crop Growth.

W. J. Elliott, Bozeman—
Butter or Cheese Making on the Farm.
Prospects for Dairying in Montana.
Why is Dairying the Most Profitable Kind of Farming.

I. D. O'Donnell, Billings.
Growing and Feeding Alfalfa.
Alfalfa and Its Possibilities.
Irrigation.

R. W. Fisher, Bozeman—
Ornamental Plants for Montana Homes.
Method of Fruit Growing.
Fungus Diseases of Horticultural Crops.
Vegetable Gardening.
The Place Horticulture has on the Farm.

W. B. Harlan, Como—
A Plan for Diversified Farming.
Fruit Growing in Montana.

M. J. Elrod, Missoula—
Birds in Their Relation to Agriculture.
The Succession of Forest Trees.
How to Keep the Boy on the Farm.
Montana's Wealth as Shown by Statistics.

Home Sanitation.
Forest Reserves and Their Uses. Stereopticon.

R. A. Cooley, Bozeman—
Cross Fertilization of Flowers.
Insect Pests of Small Fruits.
Insect Pests of the Apple.
Insects of the Garden.
Bee Keeping in Montana.
Local Insect Pests.
Household Pests.
Grasshoppers in Montana.

W. M. Wooldridge, Hinsdale—
Development of Markets for Agricultural Products.
Establishment of Permanent Rural Homes.
The Farmer vs. Transportation Companies.
How Colonization and Development Will Help the Farmer.
Co-operating Communities and How They Promote Sociability.
Church Influence on Rural Communities.

F. B. Linfield, Bozeman—
Diversified Farming.
Secrets of Profitable Dairying.
Some Experiments in Sheep Feeding.
Some Experiments in Steer Feeding.
The Cattle and Sheep Industry in Montana.
Poultry as a Profit Maker.
Growing Pork on the Farm.
Alfalfa Growing.
Butter Making on the Farm.
The Relation of Alfalfa and Clover to Soil Fertility.
Some Small Friends of the Farmer.
The Agricultural College.
The Farmers' Institute and Agricultural Education.
Principles to Observe in Growing Crops on Bench Land Without Irrigation.

Note—Others have promised assistance but a report was not received from them in time for this pamphlet.

THE AIMS AND OBJECTS OF FARMERS' INSTITUTES.

The need of mental equipment to give better preparation for and greater efficiency in the work of life is no new thought. For many generations of men, however, the thought was that this mental equipment was only needed by those born to rule either in church or state. With the growing democracy of modern times and the acceptance in theory if not in fact that the people are the rulers,has come an increase in the opportunities and a broadening of the scope of education. We have, therefore, schools and colleges not alone to train men for the professions, but to fit them for nearly every occupation in life that requires skill in the doing.

These educational forces are not alone endeavoring to build up the efficiency of the rising generation, but are gathering facts which will give mankind greater control over the forces of nature and greater efficiency in the use of these forces.

Men all over the world are delving into the unsolved problems of nature and little by little wresting from her new facts and new forces,—adding to the sum of knowledge and to man's control over nature.

In spite of all that has been done, or can be done, many of the people because of the circumstances under which they are placed can make but slight use of the facts and opportunities offered.

The farmers as a class are probably the largest wealth producers of America. They have in a large measure led the van in the onward march of progress and development. From the nature of their calling, they are scattered and isolated over the country and often enjoy but few of the social and educational advantages of those who live in the centers of population. While on a farm the necessities of life are ample, many of its conveniences are missing. Again the profits are often small and the prospects for the coming generation not encouraging. Yet from the standpoint of national well-being it is recognized that the conservative, sturdy manhood and womanhood of the American farm is a most desirable element in the stability and development of

the nation, and anything which will tend to make more pleasant and profitable the work of the farm is very worthy of promotion.

I am not sure that the plan of carrying to the people those educational facilities which they could not themselves go and get originated with the Farmers' Institute work but at least it has here found its most interesting and fullest development. The idea has been put in practice to a greater or less extent in all parts of the United States and Canada. In several of the states the work is regularly organized and large sums appropriated for carrying it on.

Montana is a new country, agriculturally speaking, and there are many new agricultural problems to be solved. The staff of the Agricultural Experiment Station is studying some of those problems. Progressive wide-awake farmers in various parts of the state are accumulating experience from their observation on their own and their neighbors farms. The aim of the Institute is to gather together all those varied experiences and to make them available to the people of the whole country.

The printed page may carry this information, but seldom or never carries the conviction or wields the influence of the living speaker. The thought is not alone to instruct those already interested, but also to stir up in the indifferent a desire to make the most possible out their farm and their surroundings that not alone themselves, but their families may be benefited. For this reason the Institute workers are sent into every locality to carry their message directly to the people.

Montana is and always will be a great live-stock state. But a change is coming over the live-stock industry. The day of open range and abundant free feed appears to be passing away. The farm will occupy a larger field in the livestock industry as time goes on and the problems growing out of these changes are worthy of the best thoughts of our best farmers. The Farmers' Institute will bring together the thoughts, experiences and the needs of the various parts of the state and do much to hasten the solution of these problems and help the dissemination of this knowledge.

Often because of the limited range of observation possible on his farm, the farmer questions the advisability or the use of attending these farmers' meetings, yet those people send their children to school and some of them to college. What for? That they might develop into better men and women, that they

might be better fitted for the duties and responsibilities of life and that they may be able to reap a larger reward from their labors than would be possible without the training. The Farmers' Institute is in a measure a farmers' school. As the student at school or college obtains a broader view of life and things, and a more thorough acquaintance with the forces at work in the world, so through contact with his fellows, some of which have made special study of special farm problems, through the variety of experience brought together from various parts of the state or country, through the enthusiasm that comes from associating with progressive thinkers along his chosen line, there is no farmer but would receive a return, that would well repay him for the day spent at these meetings. There is again the opportunity to give as well as to receive and no man can give of his experience to his fellows without getting in the course of time much more than he gave,—our prosperity is wrapped up in a large measure in that of our neighbors.

But the Farmers' Institute is more than a school, it affords opportunity for social intercourse, for co-operation of thought and industry and all the advantages that come therefrom.

As time passes the breadth and scope of these institute meetings will be enlarged and the farm and home with all their varied relationships will become a part of the work presented. Nor need the entertaning features of the farm and home be neglected as it is the desire to make these meetings attractive and interesting to both young and old.

F. B. LINFIELD.

NATIVE BLUE JOINT AND ITS VALUE.

By Thos. M. Everett, Harlem, Montana.

Mr. Chairman, Ladies and Gentlemen of this Farmers' Institute:

I have been asked to address this Institute on Native Blue Joint, Its Value as Grass and Hay and the Best Market for It.

We have our alfalfa cranks, our barley cranks, our brome grass cranks and our sugar beet cranks, but it seems that I am the first blue joint crank that the Institute conductors have been able to find; and now while we may all be cranks to a certain extent upon our pet crops, yet I find from experience that all of these pet farm products or nearly all of them have all the merit claimed for them in the localities to which they are best adapted, and that they have much more merit all over our State than most farmers know. But it does seem strange to me that a grass native to Montana, scattered over our broad expanse of valley and bench land making as it does the very best hay that is known in the whole world should not have received, and should not now receive more attention from our scientific men, from our experiment stations generally, and from our farmers and stockmen in particular.

Blue joint is what is known as a wheat grass, called by botanists "Agropyron Occidentale." It is native to the valleys and lower bench lands, especially in the coulees and swails all over the State of Montana, but without water it does not make a vigorous growth and in many places never showing above the surface of the ground for years at a time, yet living under the ground, creeping about just below the surface of the ground waiting for the life giving water when it immediately sends up a carpet of beautiful blue green, that has to my thinking the most beautiful coloring of any grass that I have ever seen. This grass is what is known as a repent grass, that is, it has creeping stems under ground, yet they are stems of grass but in an incomplete form. I have seen hundreds of acres of ground upon which not a single spear of grass could be seen for five years, the ground being as bare as this floor and the wind blowing the dirt about and yet, the

very first year that water was applied to this land the blue joint sprung up and covered the ground to such an extent that it made over a ton of fine hay to the acre and the second year made four tons to the acre. I have asked a great many men why they do not raise more blue joint hay and they usually tell me that it is the very best hay, being almost equal to other hay with grain thrown in, but that it does not yield a sufficient quantity to pay as well as other crops and therefore they plow it up and use the land for something else. Now I think that they have not given blue joint a fair show. It is a well known fact that any crop after long years of growth on the same land grows less and less and it becomes necessary to rotate the crop. Yet I have found that in 15 years of irrigating and cutting, my blue joint hay has still made a good paying crop and I think for the labor expended that it still pays better than any other crop that I could put in, but I do not think this is true of every locality. But people do not give blue joint a fair show. Did it ever occur to you that timothy after about three or four crops begins to grow less and less? and that it gets sod bound? What do you do in that event, do you say that timothy does not pay and quit raising timothy? No, you plow up the ground, put in a crop of grain or alfalfa, leave that for some one or more years and then re-seed to timothy; now blue joint requires the same kind of treatment but perhaps oftener than timothy for the reason as I said before that it has underground stems that run all about under the surface sending up shoots at every joint just like our old fashioned witch grass and for that reason it becomes sod bound sooner than almost any other hay grass, but for that very reason it is much easier renewed when it becomes sod bound than any other grass. In 1896 I plowed up about 60 acres of blue joint sod and put it in wheat, the next year, 1897, I also put in wheat, in 1898 and 1899 I sowed it in oats, each year I got a first class crop of grain, making four years that the land was in grain crop. In 1900 I just irrigated the land and did not sow anything on it, that year I cut off ¾ ton of blue joint hay per acre; in 1901 I cut two tons per acre, last year and this I cut four tons per acre from that land; during all of the time that that land was in grain the blue joint was living. By digging below the sod turned over by the plow you could see the large white tender looking stems almost as sharp on the end as a pin and the ground was full of them, while all of the land that had been turned by the plow was mellow and without a sign of grass or roots in it.

I have also found by experience that the blue joint seed is one of the most hardy seeds in existence, that there is hardly a weed seed, and everybody knows how persistent in growing they are, will stand the water and frost and heat and drouth in rapid succession that blue joint seed will stand. I first learned this in the expensive school of experience. I had some very fine strawberry plants, I had been covering them with oats straw in the fall, but one fall I was in a hurry and having no straw handy and having a lot of old blue joint hay that had been on top of a root cellar until it had rotted, so that it was not fit to leave there longer, I had it hauled and put over the strawberry vines instead of straw. This hay had been there in a loose pile for four years, yet what was my surprise to find in the spring that the ground sprang up with a solid turf of blue joint and do what I could, I could not kill it with the hoe, it took the land and I had to dig up my strawberry plants and set them out in a new place. I also find that the seed is not hard to procure and that the crop will make in our locality about 10 or 15 bushels per acre. We do not try to save the seed for the reason that it is already in the ground and does not need seeding, but I am furnishing the Department of Agriculture in Washington with 400 pounds of the seed and was surprised how easy it was obtained. The Department is going to make some extensive experiments with it in different localities and in the not distant future I expect that it will be widely known and used as a cultivated crop. Now as to its value as grass, we find with us that it is about the only grass, that when irrigated and kept growing until winter sets in, is good winter pasture. Last winter I kept a band of sheep on the aftermath which grew up after cutting the hay in August and September, and sheep gained in flesh every day that they were grazed on it which was until about Christmas, when the snow got so deep and crusted that they could not get at it, but the next spring when the snow went off I put them back on the meadow and they did well. I have also wintered cattle and horses on it for 14 years, and even work horses that were poor in the fall from hard work came out fat in the spring in each and every year. I do not think there is a pasture grass cultivated to-day that is anywhere nearly as good and nutritious a pasture grass as the blue joint for summer or winter feeding. Now, as to its value as a hay, I hardly need to tell the people of Montana, and especially of Helena, that there is no better hay on earth; it commands the highest price of any hay

in the market of Helena and all other towns where its qualities are known. At Harlem, where I live, we have worked teams on straight hay for five years at ditch work, on plows and scrapers and they kept in fair working order all of the time, and working 10 hours per day; this was before we raised any grain at that place, and I might add that our canal there, which is one of the largest and best in the state, and under which we are now growing at least 20,000 tons of blue joint hay annually was built on blue joint straight.

I would advise every farmer who has not tried this hay to procure enough seed to try at least 10 acres of it, sow it like he would timothy, irrigate it only once in the spring thoroughly, hold the water on it about two weeks if possible, it is a deep rooter and wants deep water; of course if the ground is gravelly, irrigate again about the first of June, and I think you will find the most profitable crop you ever raised. One great advantage it has over other hays is that it will stand more rough handling and rough weather in harvesting. The average cost of cutting and stacking in our valley being not more than $1.00 per ton and I always figure on putting mine up for about 60 cents per ton, not counting my teams. We cut it with six and seven foot mowers, rake it with buck rakes and stack in the field with stacker, such as the "Dain," "Acme" and "Jenkins."

Now as to the best market for the hay, we have been shipping about one-half of our product to the different cities and mining camps in the state and in Idaho and Washington, but I think the best market is in feeding it to stock to take it one year with another. Last year the price in stack at Harlem ranged from $4 early in the fall to $12 per ton in the spring. I bought a band of lambs last fall and fed them hay straight from about Christmas until the first day of April.

I did not have facilities for weighing in the lambs in the fall and weighing them out in the spring, but had a pair of common store platform scales and weighed in and out about 50 head of them, marking them so we would make no mistake, and lambs which weighed 65 pounds in December weight 108 on April 1st. One lamb weighing 42 pounds December 15th, weighed 86 pounds April 1st. All of the lambs weighed did about the same as the ones mentioned. I paid an average of $1.65 for the lambs in the fall and sold them April 1st for $3.25 and the lambs when sheared, sheared over eight pounds, which after our very hard winter and

great snow storms late in May and rainy spring was considered a remarkable crop of wool for coarse wool lambs; other lambs out of the same band, (I getting the wethers and the man who raised them keeping the ewes), sheared less than 4 pounds, they being wintered after the usual custom, and I might add that he lost about 60 per cent while my loss was about 15 head from the time I began to feed until April 1st. After paying all expense of feeding hay and caring for the sheep, I made $11.50 per ton out of the hay fed. This year hay is selling in the stack at Harlem for $8 per ton and as our average yield is about two tons per acre (some making as much as four tons and one man even reporting six tons per acre) we find that the price per acre, $16 with no plowing, no seeding and the nominal cost of about $1 per ton for harvesting, with only one irrigation, is the most profitable crop that can be grown in our locality.

DISCUSSION ON MR. THOS. EVERETT'S PAPER.

F. B. Linfield. What is the difference between the river soil and the soil up the creeks?

Mr. Everett. The river soil is uniform in quality all the way down or nearly so, but the soil at the mouths of the small creeks varies in quality at various depths and is not uniform. The blue joint does best on the river soil. However, I have found that even gumbo soil along the river raises good blue joint.

Ques. Why is that the blue joint after a few years' irrigating decreases in yield?

Mr. Everett. I have found that after a few years of irrigating the river soil seems to bake hard and this seems to be a condition unfavorable to the blue joint and kills it out. Again blue joint propagates itself largely by underground stems and thus under favorable conditions it thickens on the ground and after a time becomes sod-bound. The plant then never grows as high and frequently will not head out thus is much smaller. If this land is now plowed and cropped for three or four years to grain, in our locality, without further seeding, it will spring up and the first year yield from ¾ to one ton of hay per acre and next year double this crop, and these crops headed out. The thinning of the stand and the cultivation of the ground enables the blue joint to give a much better crop.

Remark. I had a blue joint meadow and on higher land above it there was a field of timothy and clover. In irrigating this upper piece, seeds of timothy and clover were washed down and

in time these plants crowded out the blue joint. Later a drought killed the timothy and clover and the blue joint came back and gradually increased to a full crop.

Question. Are the coarse and fine hay equal as feed?

Mr. Everett. I have fed the coarse hay to lambs and they did very well upon it. Sheep, cattle and horses eat the fine hay better but they seem to do equally as well on the coarse hay.

Question. What is your experience with brome grass

F. B. Linfield. My experience with brome grass (Bromus inermis) is somewhat limited. The brome grass possesses many good qualities. It is hardy, in that it can stand great extremes of heat or cold; once established in the ground it is very persistent; even a thin stand in time seems to thicken up due to the creeping root stalks. Stock of all kinds, too, are very fond of the brome grass whether as pasture or as hay.

To get a maximum crop some irrigation is needed or favorable rainfall. Though in many parts of the state fine crops both of hay and pasture will be obtained without irrigation. The amount of crop will depend somewhat upon the nature of the soil and the amount of rainfall. Brome grass gives its best crop of hay when the stand is not too thick. Under favorable moisture conditions the brome grass thickens on the ground and becomes sod bound. It is then advisable to plow it up and this thinning and loosening of the soil will enable it to give a good growth of hay. If plowed in the spring and the ground harrowed smooth, brome grass will start without further seeding.

Another difficulty with brome grass is the trouble in getting a stand, due to poor seed or to unfavorable soil conditions. The cure for this trouble is self evdent. Get good seed and have the seed-bed well prepared.

That brome grass does well in Montana, samples I have seen growing in various parts of the state bear witness. In Beaverhead county I saw a small plat (2 acres) that the owner told me yielded over two tons per acre, at one cutting. It stood about three feet high. I have also seen excellent samples of brome hay from Cascade county.

DISCUSSION BY W. W. GAMBLE ON THE "VALUE OF OF BLUE JOINT HAY."

The writer attended the Farmers' Institutes at the State Fair. The big tent of the institute on the Fair grounds had been blown down and the institutes were held uptown in a hall. The writer

became a convert to the idea that a State Fair was not the best place for a session of the Farmers' Institutes. A State Fair is not primarily an educational institution, as the writer had supposed it might become, but is rather a place where people go after object lessons but this also is education to a degree. So many things at a fair, and including of course the race track, distract the attention and render one's habit of thought intermittent and irreguular, to an extent that prevents the necessary concentration of mind upon the important topics presented at Farmers' Institutes.

The Farmers' Institutes at the State Fair, were, however, not a failure. The institutes were held and papers were presented and read and the effort made was productive of results. As an evidence of this I would like to call attention to the paper read at these institutes by Thos. M. Everett, of Choteau County, upon "Native Blue Joint Hay and Its Value," as published in the October 15th issue of the Stockman and Farmer. I do this because I believe that this reliable paper has not perhaps been taken as seriously as it should be. In the opinion of the writer, this article alone is worth more than the whole cost of the effort at Farmers' Institutes at the Fair Fair.

Let us consider this paper a little in the effort to get the substance of what Mr. Everett says: First, his effort is calculated to renew our faith in the most valuable of all our native grasses. Certainly some one of the many varieties of grass we see around us and native to the soil, ought to stand the test of time and the competition of timothy and clover, and endure with us forever. In our section of the state we had become not a little discouraged about the future of wheat, or blue joint grass as it is generally called, and had about settled down to the conviction that the appearance of this grass was something especially designed by Providence to come to the assistance of the new settler to aid him in his first efforts, and that this purpose being accomplshed this wheat or blue joint grass was to vanish as suddenly as it had mysteriously come and give place to new and highly improved varieties, to be introduced by the settler himself once he got started; and it would seem that the new settler generally has been quite too willing to sacrifice the friend who so opportunely came to him in his time of need. But this seems to be the way of all the world, and in this case the friend seems to refuse to be sacrificed.

Mr. Everett lays full stress upon the fact, that wheat or blue

joint grass grows less and less upon the land as the seasons go by, that it becomes sod bound as soon, or sooner, than most other grasses, and that a rotation of crop is necessary. But here comes Mr. Everett's strong point. The manner of rotation is the most remarkable example of a rotation of crops known to agriculture. According to Mr. Everttt, and we think he is correct in his statements, this rotation of crops is incident upon the most radical method of cultivation known to history: he simply plows the land, sows it to grain for one year or for several years, reducing all inequalities of the land by a thorough harrowing, and after raising a crop of grain he lets the land lie fallow, when lo! a heavy crop of wheat or blue joint grass comes in and reoccupies the land, and this without any reseeding. This is simply a tale from the Arabian Nights worked out in agriculture. This is a romance in the vegetable world that is not a fiction.

RAISING OATS IN BEAVERHEAD.

By J. E. Morse, Dillon, Montana.

In discussing this subject I shall endeavor to tell you in as few words as possible the methods employed by me on my ranch.

Preparing the Land for Seeding.

In preparing the land for seeding it is necessary to begin nearly a year in advance, and to do so we commence irrigating as early as May 10th, thus getting the use of the high water in the spring. We continue to irrigate for summer fallowing during May and June, as long as water can be spared from growing crops, and commence again about August 10th, and continue until it freezes up in the fall. We thoroughly soak the land, and plow as soon as the top is fairly dry—we begin plowing or summer fallowing. We plow from five to six inches deep, and after completing a land, we take a small plow and fill the dead furrows, and also replow the corners where horses have tramped it. We use three Gang Plows with No. 40 Oliver bottoms drawn by eight good horses, and with such an outfit average about seven acres per day. We never undertake to plow ground unless it is first thoroghly soaked, and the success or failure of the crop largely de-

pends on getting plenty of moisture below the surface of your seed bed.

Leveling.

Soon after plowing is completed the corners and dead furrows are thoroughly disked in order to pulverize the soil so that the land may be more thoroughly leveled. We next use a long leveler 24 feet long, made of heavy logs or square timbers, drawn by six or eight horses; we run diagonally with the way the land was plowed. When we have run over the ground with this leveler once, the disc is again brought out and the corners and dead furrows are again gone over, when we again go over the land running diagonally with the way it is plowed, but just opposite to the way it was first leveled. This second leveling will generally put your ground in first class shape for seeding.

Seeding.

During the time you are "resting" in the winter, look up your seed for next season, and if not thoroughly clean run through a fan mill, taking out all the foul seed. As soon as the frost is out of your ground and it is thoroughly dry on top begin seeding. This work can generally be commenced during March. We use the Monitor disc drill with 22 or 24 double discs; they are five inches apart; this drill is drawn by four horses, and from 16 to 20 acres is considered a fair day's work. The discs generally run into the ground three inches putting the seed into the moist, mellow soil so that all seed will come up evenly, producing good strong plants. For early seeding, say before April 15th, we find 85 pounds per acre sufficient amount of seed, which should be increased to 100 pounds or more for later seeding. For early seeding, say up to April 10th, it is not generally necessary to disinfect seed for smut germ, but after that date would advise the use of vitriol or formalin. It is no doubt advisable to use luke warm water in treating seed for smut germ. Upon this subject, however, would advise proceeding with caution and seeking advice from your neighbors who have had experience in this line. Do not think it advisable to plow ground after May 10th to be put in crop same year, as on ground plowed after that time the crop is generally a partial failure. We find that early seeding brings a much better crop under the same conditions than the last seeding on spring plowing.

Irrigating.

As soon as seed is planted get your ditches in readiness for irrigating. We first plow out our laterals, using a double mould board or lister plow attached to a sulky frame, drawn by four horses. With such a plow an experienced irrigator with a good mechanical eye can run laterals on the highest ground making them from 30 to 150 feet apart, according to conditions. These laterals are supposed to be 16 to 18 inches wide in the bottom, and the plow making both banks at the same time. As soon as the laterals are plowed, start your teams hauling either stable manure or half rotted straw filling your laterals at the highest points where you desire to turn out the water. We put these manure dams as close as 20 feet apart, but generally from 60 to 70 feet. You will find them a great saving in work, and much larger streams can be handled in this way than by any other process we have used. Next see to it that your head ditches are thoroughly clean and of sufficient capacity to readily carry the water you are likely to turn into them. As soon as the grain is from three to six inches high it is generally a good idea to begin irrigation. We use 120 statutory inches or three second feet of water to each man running it in two lateral ditches. Much time and patience must be used in the first irrigation. We endeavor to turn water on the head of new lands at night, that as little water as possible will be wasted during the long hours of the night, and by having plenty of dams put in, it can generally be controlled.

As soon as the first irrigation is over we have an extra man follow two irrigators, whose duty it is to put in these manure dams, mixing the manure with soft earth. By this process these dams dry in the sun and become quite solid like brick, so that the second irrigation becomes much easier and a larger amount of water can be handled.

The second and last irrigation should follow the first one in 12 to 25 days, and as grain at this time is quite well advanced much more water can be handled. We figure on 200 statutory inches or five second feet to each man, and by having your dam built in advance a much larger head can be used. During the second irrigation it is profitable to put on two shifts of men, changing at noon and mid-night.

Rotation of Crops.

It is no doubt a good idea to have a rotation of crops, raising alfalfa and oats alternately, say two or three years of each crop

in succession, and by so doing much greater returns can be secured for labor expended than by any other manner of farming. There is little doubt that the future successful farmer and oat-raiser will use this method.

Wild Oats.

In dealing with this subject I shall not speak from personal experience, having never been troubled with them, so will only deal with them from a point of observation. It would seem that the best way to avoid getting them is to cut the grain before getting too ripe, thus avoiding the scattering of the seed on the ground; if your ground becomes impregnated with them the quickest and surest way to get rid of them is to thickly seed to alfalfa. By cutting your alfalfa twice a year your ground will be absolutely clean in two years, when it can be broken up and grain again raised.

DISCUSSION OF PAPER ON OATS BY J. E. MORSE.

G. R. Featherly. You cannot depend on cutting your grain early to kill wild oats because they ripe very early.

J. E .Morse. I have only raised oats two years and I only speak from my experience and what I have heard. I don't have any wild oats. I always vitriol my oats before planting.

G. W. Perkins. I have never had any smut, but I have seen grain sowed about the 15th or 20th of March, that had smut and some that was sown in May. I not only saw it but watched it.

G. M. Featherly. I never vitriol but use formaldehyde for oats. and I never have had any smut until last year, but I had plenty of it then. I am inclined to think that it was because the grain was put in late.

Remark. Smut is something like foxtail, some years it grows better than others.

G. R. Featherly. I always thought that grain sown early would not have any smut, but I may be mistaken. How many use formaldehyde to kill smut? I used it last year on my wheat and prefer it very much to vitriol. It is not so hard to handle. All you have to do is simply to dilute with water and sprinkle it on the wheat but if you use it for oats it is better to dip. I am in favor of it for smut; use 1 pint of formaldehyde to 40 gallons of water.

J. E. Morse. The only grain of mine that had smut in it was a little piece that was put in in May. This one peice was put in late. Different conditions have a great deal to do with smut.

This was sown only one day later than the rest but was not vitrioled.

F. B. Linfield. Was it the same seed as the other?

J. E. Morse. Yes the same.

G. R. Featherly. What got the best of me on vitrioling was when I first tried it. I dissolved the vitriol in a tin can and went out into the field and when I came back the can was gone, It had eaten it all up.

Remark. How much vitriol to 100 pounds of oats do you use?

G. R. Featherly. I do not know. I am not an authority on that. I have heard that you can use too much and kill the oats.

Martin Sorenson. We always use one-half pound to 100 pounds of oats; use 1 pound of vitriol to 15 gallons of water.

DRY LAND FARMING.

By F. B. Linfield, Agriculturist Experiment Station.

Dry land farming as it is conducted in these western, arid states is the raising of crops without irrigating the land upon which they are growing. This is the usual method of raising crops in the humid region, where the rain is expected to supply all the moisture required by the growing crops and at the time when needed.

When dry land farming was first practiced in Montana I have no means of learning, but it has been only within the past 10 to 15 years that much attention has been devoted to it while perhaps five years would cover the time during which this method of farming has been extensively practiced. It is, however, yearly receiving more and more attention.

It would probably be useless to attempt to grow a crop without irrigation on any upper bench land, where the surface soil is thin and underlaid by a gravelly subsoil. Such soil has little or no power to hold moisture. The most of our valley and bench lands, however, is not of such a nature, but as a rule is a dark alluvial loam with good retentive powers. I have seen a paying crop grown without irrigation on land ranging from a clay loam to almost a sand when the subsoil was not porous.

This virgin bench soil is generally very rich in mineral plant food and often in humus. For generations the weathering influences have been at work dissolving the soil, yet because of the light rainfall but little of it has been washed away. This brings us to the one need of the soil, viz., water.

In the growth of plants, water is needed (1) to dissolve the plant food in the soil, (2) to carry the plant food to and through the plant and (3) to be used in building the substance of the plant. Experiments have shown that for these several requirements the plant uses about 500 pounds of water for every pound increase in dry matter. The most of this large amount of water passes through the plant and is transpired by the leaves. It is by means of this water that the plant takes up its food in very dilute solutions from the soil. Perhaps to an irrigator it would be interesting to place these figures in inches in depth over the land for the production of any given crop. A crop of 40 bushels of wheat per acre, assuming that about one-half the weight of the crop was straw, would give about 5,000 pounds of dry matter per acre. This would require according to the figure given 2,500,000 pounds of water or in round numbers about 12 inches of water applied on a level all over the field; 20 bushels of wheat per acre would only require 6 inches of water on a level, and four inches of water should produce about 13 bushels per acre. In other words the number of inches of water mentioned applied to land, if it could all be saved for the use of the plant would produce the yields mentioned. These facts go to show that under average conditions enough rain falls in many parts of the state to grow profitable crops could we but save it for the use of the crops.

But water is needed and the source of supply, whether used as nature brings it or applied artificially, is the rain and snow which fall during the year. Even the irrigation water so comes, but the rain which falls over large mountain areas gathers together in spring, stream and river and is again applied artificially to land by man. Over a considerable area of Montana the rainfall is from 15 to 17 inches on the average. This rainfall must be the sole dependence of those who attempt to farm in Montana above the irrigation ditch.

Those below the ditch, however, or even below any prospective ditch, (even if late in the season the water supply gives out) may yet find a value in the flood water of the early spring, or in the water running to waste in the fall after the irrigation season is

over. A study of the practice of irrigation in the state shows that water is used for irrgation only about two or three months of the year, at other times, which includes considerable of the flood water season, the water flows past the land and out of the country. Can this water be utilized?

From some observations made it would appear to be a practice worth considering to use the surplus water of the fall and the flood water of the spring to irrigate land and to load the subsoil with water. The observations on this point are as yet rather meager and considerable work must be done to fully demonstrate what this practice has to offer. The data at hand indicate its probable profitableness.

When rain falls upon land which is hard and compact, some of it may penetrate the soil and some may run off, the proportion going in either direction depending upon the heaviness of the shower, the nature of the soil and the slope of the land. If this soil was loosened to a depth of say, 8 to 10 inches by plowing, and left rough, but not open enough for the air to circulate through it, all the water that falls upon the land would soak into it, none would run off.

Observation and experiment has shown that when soil is hard and compact the moisture that is contained in it evaporates very rapidly from the surface into the air. Moisture deep down into the soil is brought to the surface in the same manner as the oil in the lamp is brought to the flame, and as we have noticed, if the supply of oil gives out, the wick is pumped almost dry before the flame goes out. So the evaporation from the surface soil tends to draw the moisture up and if it is not arrested it goes off into the air as vapor. It has been found in practice that surface tillage, which tends to break the pores by means of which the moisture comes to the surface, prevents the evaporation of the water in the soil. This loosened soil acts as a mulch and in our dry atmosphere may with advantage be three inches deep.

Land if plowed late in the fall should be left loose and rough. In such shape it readily absorbs the water that falls and the winter rains compact the soil. However, in a windy country it might not be advisable to fall plow as in that case the snow is often blown away and sometimes much of the soil also. Under these circumstances leave all the grass and stubble possible on the land to catch and hold the snow. When plowed in the spring, plow as early as possible and follow the plow as quickly

as possible with some tool that will compact the sub-surface soil, though leaving the surface loose. This will close up the opening in the soil, prevent the too rapid circulation of air and the consequent loss of moisture.

Both fall plowing and the spring plowing after being compacted as stated should be frequently cultivated to keep the surface soil of the field loose, thus preventing the evaporation of moisture. Even if the surface soil is dry and loose, occasional cultivation is needed to attain the best results in saving the soil moisture. In sowing spring crops, of course this cultivation cannot be kept up all summer.

Frequently because of the small amount of moisture it will be best to conserve the moisture of two years to be sure of getting a crop. The land is summer fallowed one year and cropped the next. This practice fits in well with the growth of fall crops, and in the dryer districts gives greater assurance of a crop than cropping every year.

A very interesting illustration of the advantage of thus cultivating soil was shown in an orchard owned by Mr. Benedict of Park City, Mont. An orchard was set out five years ago above the ditch and no water has been applied since the first year. But the orchard has been cultivated well in the spring and frequently all through the summer. A more healthy, thrifty lot of trees a person would not wish to see and one acre of ground last season produced 150 boxes of apples.

In selecting crops suitable for growing upon these dry land benches without irrigation a few general and characteristic requirements must be kept in mind. The plants must be (1) rapid growers that ripen early so as to reach their maturity before the available moisture is used up. The plants must be (2) deep rooted so as to gather their moisture supply from as large an area of soil as possible. They must be (3) hardy, vigorous varieties to live through the adverse conditions likely to arise and to make quick use of the favorable ones, and lastly if grain is desired, thin seeding must be practiced otherwise all the soil moisture may be used up in the leaf and stem growth and none may be left to mature the seed. Only good, plump seed of course should be used.

Of the cultivated plants the one, perhaps, that comes nearest to filling all these conditions is fall rye, a hardy plant, an early and vigorous grower. Because of its early growth it will stand

thicker seeding than any other of the grains. If cut for hay, it should be cut as soon as it comes into head, otherwise it soon gets woody and unpalatable.

Fall wheat is most largely grown as a grain crop on the dry land farms of Montana and in fact of the whole west. A deep-rooted plant, fairly hardy and an early ripener, it often gives very large yields in favorable seasons. Wheat requires a fine seed bed and a fairly good start in the fall. It should not be sown too thickly in a dry dstrict. I have seen one-half bushel of seed per acre yield 30 bushels. Even in a dry season most of the plants will ripen seed and in a favorable season the plants will tiller and give an excellent stand.

Of the spring sown grains, bald or hulless barley, because it ripens early, and maccaroni wheat because of the hardiness and vigor of the plant seem to stand at the head. Speltz is also worthy of a trial. In some places in the state oats have done well but use an early ripening variety. All spring sown grain should as a rule be sown as early in the spring as possible so that it may take full advantage of the spring moisture.

All of the above grain plants may also be cut for fodder and make good feed if cut early enough. In districts where the nights are warm sorghum and millet may be added to the list.

Of the perennial grasses, smooth Brome grass (Bromus inermis) is probably one of the best. Timothy is also grown in some of the moister districts. In starting these grasses, a good seed bed should be prepared, good seed used, and the seed sown in time to give it a start in the fall or early in the spring.

The soil of the arid west generally contains as abundance of mineral plant food, sometimes a superabundance, when we know it as alkali. The only probable deficiency which the continued growth of cereal crops is likely to intensify is a lack of humus and nitrogenous plant food. These facts make it important to find some legume that may be used in the rotation on the dry bench lands to supply the necessary nitrogenous material. On this point there is room for some careful and extended experimental work. In addition to the requisites mentioned above, this leguminous crop must be easily started and a profitable crop, though something on the latter point may be sacrificed for the benefit to the soil and to subsequent crops.

In many ports of Montana, I believe alfalfa may be grown on the bench lands without irrigation and in other places successful

crops may be grown by irrigating with the flood waters of the early spring. Alfalfa is a deep rooted plant and can withstand drought well. Its weakness is the difficulty of getting it started and through the first year, till the root gets deep enough into the soil, and second, the danger of winter killing in cold and unfavorable seasons. To insure a start an extra fine seed bed should be prepared. Plow the land in the fall to retain all moisture possible, cultivate early in the spring, sow early using good seed only. When plants are 8 inches to 10 inches high mow the alfalfa leaving plants for a mulch on the ground. It may again be treated the same way when it grows up, but the later growth may be left standing to collect the snows of winter, affording protection to the roots and collecting moisture for next season. If by this careful management the plants can be carried over the first season, in many parts of the state a fairly good hay crop may be expected for two or three years, though as a rule but one hay crop will be obtained for the year. It is probable that in time other plants, and annual leguminous crops may be found that will prove useful in maintaining the fertility of these bench lands.

For some years past the Experiment Station has been conducting experiments to find the amount of water needed to grow crops. The past season with the moisture stored in the soil and 6 inches of rainfall during the growing season, we obtained 34 bushels of wheat per acre. With 12 inches of rain and irrigation we got 40 bushels per acre; 18 inches of rain and irrigation gave 45 bushels per acre; with 2½ feet we got 47 bushels per acre and with 3½ feet but 43 bushels. With the potatoes the results were even mode favorable to light watering. The moisture in the soil with 6 inches of rainfall gave almost the maximum crop and much the fined crop—315 bushels to the acre. The land, however, was frequently and thoroughly cultivated; 3½ feet of irrigation and rain water gave only 244 bushels per acre and a much inferior quality.

Practically, therefore, as well as theoretically, the results show that a profitable crop is possible with a small amount of water if it can be all saved for the use of the crop.

ALFALFA GROWING.

By G. R. Featherly, Dillon, Montana.

I consider the question of alfalfa the most important one that we have to deal with, for it is of interest to both the farmers and the stockmen. To the farmer, who has been raising grain and timothy hay, it was a godsend, because our oat fields had become foul and very much run down. Wild oats were getting the best of most of our ranches and our timothy meadows had run to foxtail to such an extent that we could not sell our hay, nor was it any good for feed.

Alfalfa was introduced in this valley about 12 or 13 years ago and I cannot say by whom, and it does not make any difference, as long as it is here. Before it was grown to any extent you could ride along our roads and the stacks of hay that could be seen were indeed few and small. Now this is all changed. You can see on any of our ranches, no matter how small, great ricks of hay and large straw stacks, and you wonder where they were grown. Alfalfa is a beautiful plant and makes our ranches look nice in the summer time and surely the large hay stacks make them look very healthy in the winter time. Now a man with 160 acres can go ahead and do something. Suppose that he sows and plants 50 acres of each. The first year, if he plants with oats, he can get a fair yield of oats and a stand of alfalfa and some good pasturage. Then, as he gets the system in working order, see what he can produce. Now he ought to get four tons of hay per acre every year. This will mean 200 tons worth $5 per ton, or a money yield of $20 per acre. Then again alfalfa is not hard on land because it draws the greater part of its substance from the atmosphere. The soil is rather rested than impaired. Then the great roots of the plant make it, when plowed up, a great fertilizer; It is better than anything I have knowledge of. This I know to be a fact because of the great amount of ground that can be covered and the good results which have followed. Just think how much manure would be required and how long it would take to spread it over 50 acres of ground. When alfalfa is used all you have to do is to plow up the ground in the fall and the results are

just as good and just as lasting as when manure is used. In addition, it is a great deal cheaper, as it will hardly ever cost more than $3 per acre to seed.

Then what do you get? Why you just about double the amount you can raise on an acre and this is no dream. Last year I raised over 100 bsuhels of oats to the acre on some of my alfalfa land. Now this is not only my experience, but my neighbors will all bear witness to the same experience. Now is it strange that we take so kindly to this plant It is surely not miscalled when it is called the "Farmers' Friend."

The stockman situated so that he can grow alfalfa is fortunate indeed, because he can just about double the number of stock he can care for during the winter or feeding time, either sheep or cattle.

Here I will use some figures compiled by Mr. I. D. O'Donnell, of Billings, Montana. They are taken from the paper on alfalfa which he read before the institute at that place last year. One acre sown to alfalfa and irrigated will produce from 8,000 to 10,000 lbs. of hay. One acre of enclosed pasture will produce 500 pounds of hay; one acre of range will average 250 pounds of hay. Or again, one acre of irrigated alfalfa will feed one steer 400 days; one acre of enclosed pasturage will feed the same animal for 20 days; and one acre of average range land will feed him 10 days. Or for sheep it will be this way: One hundred and sixty acres of irrigated alfalfa will maintain 1,600 sheep for a year; 160 acres of enclosed pasturage will pasture 80 sheep for a year, while 160 acres of average range land will only maintain 40 sheep for a period of a year.

By these figures we can readily see how it would be if we could get alfalfa to grow on our foot-hills and benches where we have no water. I tried a little alfalfa, some brome grass, some vetch and some timothy on our bench land last spring. It all came up, but all of it died except the alfalfa and that was alive and looking well last fall.

Alfalfa is not grown to any extent in this county outside of the Beaverhead valley. In the Big Hole basin it is said to be too high, but has, perhaps, not been tried there. If it could be grown in this place it would be of great value to the stockmen. This is also true of other parts of the county. I think that wherever oats can be grown so can alfalfa. It is not necessary for me to give in this paper the method I use for seeding and

harvestng this crop. I gave that last year and it is found in the first annual report of the Montana Farmers' Institutes. This little book should be in the hands of every farmer and stockman of the county. I have, perhaps said more than I intended to when I started out. I thought that I would just write enough to get the subject before the meeting for discussion, but there is so much that can be said that a fellow does not know when to quit.

MARTIN SORENSON ON FEEDING.

I have not had very much experience in this line. I have only fed two years. I have done that I think with fair success. The first winter 1899-1900 I fed a number of steers. I fed only wild hay, the last month, however, I fed them on alfalfa and I am satisfied that the cattle gained more in the last month and one-half on alfalfa than they did on wild hay. I have heard it said that cattle would not ship well being fed on alfalfa, but they came through in good shape and brought $4.65 per hundred when corn fed cattle only brought about $4.25. All during the feeding they looked as good as any others.

Last winter I fed some, part two-year-olds and part three-year-olds and they did just as well as those in the Big Hole. We had scales near my corral and weighed the steers and they gained 2¼ lbs. per day for two weeks. I consider that alfalfa will do as well as any wild hay not excepting the Big Hole wild hay. In regard to feeding I believe in starting to feed early because one week in the fall they lose more than you can put on in two or three weeks. I believe in feeding often and only a little at a time.

Question. Are the financial results for feeding alfalfa satisfactory?

Martin Sorenson. Steers will do a little better I believe on alfalfa than they will on wild hay. They will take about 40 lbs. per day. When I first began feeding I had some good wild hay left over and the animals left the best wild hay for damaged alfalfa. A steer will do better on what he likes best.

J. E. Morse. What about stems? Did they eat the stems up clean?

Martin Sorenson. I make it a point to clean my feeding racks every day or two. They will leave some stems especially of the first cutting. Of the second cutting they do not leave hardly any. I probably get 100 lbs. out of every ton of hay.

J. E. Morse. Did you feed with the same style of racks that are used in the Big Hole?

Martin Sorenson. Yes, the same kind.

A. J. Noyes. We have of course large ranches where they do not raise wild hay. There is just one partcular section between the Point of Rocks and L. A. Brown's place. We have a large area here that they do not raise alfalfa on. The cattle of the Big Hole and Horse Prairie that have been there all their lives have missed a great deal by not having seen an alfalfa stack. I have raised the best beef there ever raised in Montana unless it is grain fed. If an alfalfa fed animal were taken out of the Big Hole basin there would be nothing left but the head, tail and a few bones as the result of the long drive. It is a four or five days drive before they can be put on the car and shipped to different sections of this country. That the cattle fed in the Big Hole basin have flesh hard enough to stand this long drive is sufficient proof of the feeding value of wild hay. They raise about 75,000 tons of hay in that section and almost all of it is wild.

G. W. Perkins. How long do you generally feed cattle in the Big Hole basin and how long does it take to fatten them?

A. G. Noyes. They get fat very readily in ninety days. The first experiment made was with 98 head and began the 25th of December. They were taken out four months later and they could not have been fatter unless they had been grain fed. There is one draw back we do have in the Big Hole basin and that is we have so much snow that it is cold for the cattle to lie down. If we had the warm places you have for them our conditions would be almost perfect.

G. R. Featherly. I do not pretend to say that you cannot fatten beef in the Big Hole basin. You people claim that we cannot fatten cattle on alfalfa, but we can, and the feed is just as good as the Big Hole feed.

G. W. Perkins. My opinion is that cattle fatten in less time on alfalfa than they do on wild hay.

Martin Sorenson. I only fed mine sixty days and the Seattle man pronounced them good enough to ship there.

G. W. Perkins. You could not do that on wild hay.

F. B. Linfield. About how many tons of wild hay do you get per acre?

A. J. Noyes. We do not grow to exceed a ton on irrigated

land. Some pieces may have more than that but it will not average that.

F. B. Linfield. What is the altitude there?

A. J. Noyes. 6,000 feet and over.

F. B. Linfield. When an animal will eat more I usually let them. All animals will eat more clover and alfalfa than they will of hay. I believe, in feeding alfalfa or clover either in fattening sheep or cattle that you can put a better finish on them by feeding grain. This is a queston each must answer for himself in his particular locality. You cannot apply the rules of one valley to another. The question that comes to me is whether Mr. Sorenson thinks cattle would do as well, under equal conditions, in the Big Hole as here.

Martin Sorenson. According to my experience I think they will. I believe cattle will do as well in the Big Hole Basin on alfalfa as they would here.

J. E. Morse. There is no question but that the Big Hole hay is all right, and I believe that two tons of Big Hole hay will put on as much fat as three tons of alfalfa, but we have this advantage. When we have our alfalfa fat on the animals we can get them to the railroad without running it all off. There is no question that if they had a railroad as close as we have their animals would go into market looking better than alfalfa fed cattle.

ALFALFA.

By John C. Murray, Dillon, Montana.

The name of this great forage plant is derived from the Spanish alfalfey; in French it is called lucerne; in South America caahan clover, while in Arabia it is named alfaefach, which means the best kind of fodder. In Utah the Mormons observe the French name presumably for the reason the name is an easy one. In the great change that is now going on in the stock industry alfalfa is playing an important part. The change from the open range system with no provision for winter feeding has been gradually under way since 1896. It is bound to advance for winter feeding has been gradually under way since 1896. It is bound to advance more rapidly in the near future, and will in time give way completely to a system of pasturage and feeding. To supply cheap and nutritious fodder will then be the problem for the stockman, exactly as securing a good and sufficient range is to-day.

There seems little reason to doubt that in the solution of this problem, alfalfa will be the chief factor. Brome grass or clover which flourish in dryer localities and is successfully grown in some localities, will furnish a part of the necessary feed, but the greater portion must come from alfalfa.

The success which has attended the cultivation of this plant in some parts of Montana, the enormous yield, its fattening qualities, its increased value where fed to stock, and many other considerations all mark it as the ideal forage crop. Farmers should not be discouraged over the failure to obtain a stand of alfalfa, on a certain or in a particular season. There are times and places to get good results, careful study and comparison of methods and conditions will invariably lead to success. Constant experiments are being made, and then success has established alfalfa as one of the great crops of Montana.

I have always made it a practice of sowing alfalfa seed with grain. Oats or wheat as the case may require, and have always secured a good stand. I use a drill with a seed attachment, and

let the seed fall directly in front of the drill shoes, thus covering the seed to a depth of an inch or two. I sow from 25 to 30 pounds to the acre, and have invariably had good results, besides I get a fairly good crop of grain, and get the plants started with the same labor that it would take if the alfalfa were sown alone. It is very necessary to get the grain hauled off as soon as possible and give the young plants an irrigation in the fall to keep them moist during the winter, and to have moisture in the ground the following spring to start the plants. Then one irrigation in May or June will make the first crop of hay. Some people prefer to sow the seed on thoroughly prepared ground alone, and have had good success sowing as much as 35 pounds of seed to the acre.

About nine years ago Mr. Nathan Hobson put in a piece of alfalfa in this way; plowing the ground up and leveling it thoroughly, sowing the seed about the first of June, and he had good results. This piece of alfalfa is still good and cuts from 3 to 5 tons of hay per acre, annually.

Harvesting alfalfa at the right time and in the right manner very often determines its feeding value. The majority of ranchers wait too long before starting the mowing machine. Alfalfa should be cut for hay when one-fourth of the piece is in bloom. When left to stand longer the leaves on the bottom fall off, and are wasted, and the stems or stalks become woody and lose strength. Mowing early stimulates the growth of the following crop. I find where one has a large acreage to cut it is difficult to get it up in good shape. There is always considerable of the crop that gets too dry before stacking, owing to hot winds and other causes; some gets too old before being cut, windy weather and an occasional shower in July retard the work, and the consequence is you have some hay that is not first class. This hay can be fed to range stock or work horses to good advantage.

DISCUSSION AT DILLON.

J. E. Morse. Last year I asked how to reseed alfalfa and also asked them how to keep foxtail out. I did not get very satisfactory answers. No one seemed to be able to give an exact answer. I went at it myself to work it out. I cut it up with a disc harrow like a plowed field. After cutting it up and harrowing it, I put water on and the results are alright. I more than doubled the amount of hay I had gotten from that land the year before. Some of it gave three times as much and a very much

better quality. The leaves were on the stems down to the ground and I do not think I had to exceed one-tenth part of the foxtail I had before. I want to say that I think it is a great result to get out of this kind of work. I am going to try it on nearly all the alfalfa I have.

I think following it up with water soon after the first of May helps it out. Some say that is too early, but I find it starts better. Some people will tell you the first of June or the middle of May. I would be very glad to hear the experience of any one else in that line. If you can cut foxtail out it is a very important matter.

G. R. Featherly. You recommend discing. At the Kansas Experiment Station I notice that it is recommended.

J. E. Morse. I used discing after each cutting and I find it greatly increases the amount of hay per acre.

G. R. Featherly. I would not dare chance it after each cutting. I have too much other work to do then.

Perkins. We cut foxtail and let it dry on the ground sometimes, and put straw on top of it. Then set fire to it and it kills both root and seed.

G. R. Featherly. Did you ever try dandelions that way?

Perkins. I think if dandelions are plowed in the fall and again in the spring when they begin to grow again, it will kill them out. That is the way they have been killed on my ranch. I think they came up more some years than others.

F. B. Linfield. Are they troublesome on cultivated land or seeded land?

G. R. Featherly. Seeded land more particularly. They certainly get pretty bad in hay and alfalfa.

Remark. The will kill out hay in time. As far as foxtail is concerned I do not believe discing does much good. I have tried it several years and cannot see much difference. Two years ago the foxtail was thicker than I have ever seen it and last fall there was none and I never used a disc.

G. R. Featherly. Didn't you kill it out by continually cutting it.

Remark. The only remedy I ever found for it is to plow it up. I have found too that you can get a good stand of alfalfa by putting in thirty pounds per acre. An important point is to have the ground in good condition. I would like to hear from some one who has had more experience in raising alfalfa.

G. R. Featherly. When I first sowed alfalfa I opened the drill so that I could sow all that was possible. I believe in putting in lots of seed to the acre. Twenty pounds of alfalfa seed and five of timothy are sufficient for an acre but the idea of sowing of alfalfa and having it thick is that it is not so liable to get woody.

Remark. What is the difference just so it is thick on the ground.

G. R. Featherly. It is possible that some of the seed does not grow.

Remark. There was a farmer in this country who did not have any experience in growing alfalfa. He used a seeder and put in what he thought was about right. He put in about 150 pounds to the acre. I came over and told him he was sowing too much and then he used from about 15 to 16 pounds. What he sowed first did not make any better hay than where he sowed 15 pounds. I do not think it is a good plan to put in so much seed.

F. B. Linfield. As far as the amount of seed is concerned, 10 pounds will cover the ground quite well and the seeds will be close together. You can figure it out by the number of seeds to the pound. It must be sowed in fine moist ground or a lot of the seed will not germinate. Under these circumstances 15 pounds will be sufficient.

Another question is whether your seed is good. Sometimes it is not. I have seen 10 pounds give as good a stand as any body wish to see, but the seed bed was in very good condition.

Remark. If the ground was not in good condition thirty or forty pounds would not do any good.

G. R. Featherly. Don't you think that alfalfa that is thin on the ground has stems that are woody.

F. B. Linfield. Undoubtedly, but the seed bed must in good condition under any circumstances. I prefer twenty pounds to the acre for the reason that the ground may not be in good condition.

G. R. Featherly. I always figure on two or three pounds not being good.

DISCUSSION AT CHOTEAU.

F. B. Linfield. How many of you have tried alfalfa?

Remark. I have tried it, but on irrigated land.

F. B. Linfield. How did it do with you?

Remark. Three years ago I put in part of an acre sowing

about four quarts to the acre and it got a very fair start. Next year it was much thicker, but I watered it late in the fall, that is, part of it. I could not get all over the entire piece. The part that was not watered did not kill out, but the rest did.

F. B. Linfield. Do you think a late watering was the cause of the killing out?

Remark. I think so, because I did not get water over all of it and what I did not irrigate was alright. Next year I put in five acres and seeded about four quarts together with oats to the acre. This was put in the ordinary way and the alfalfa did very well. Last summer it was cut for the first time and gave about 1½ tons per acre.

F. B. Linfield. Do you think it is a success?

Remark. I do not know yet.

F. B. Linfield. How much do you get from dry land?

Remark. I think it was about the same. It grew about 2½ feet high.

F. B. Linfield. About what was your yield?

Remark. This is the first year we have mowed and we got quite a little. We had used it for hog pasture before until it killed out. We had some that was cut the first year, but the frost killed it out entirely during the next winter. The land was not irrigated.

F. B. Linfield. The difficulty on land that is not irrigated is in getting a stand.

Remark. On this piece we had as good a stand as a man could have, but it was on wet ground and it killed out.

F. B. Linfield. Alfalfa will kill out unless the water table is more than four feet below the surface.

Remark. We had about ten acres and it was the same way with that.

F. B. Linfield. Has anybody tried alfalfa on bench land without water?

Remark. I had some, but it was irrigated.

Remark. How is this elevation for alfalfa? It is about 4,000 feet here.

F. B. Linfield. The question of elevation is merely a question of cold in winter time. As far as elevation is concerned if it does not give you too much cold weather it is alright. I believe where you have it warm enough for the alfalfa to thrive well you need not be afraid of the elevation.

Remark. It is not any colder here than it is in Chinook. They find that sometimes alfalfa winter kills there. But when a crop produced five tons per acre I would chance a few killings. I was surprised to hear that with care and irrigation they sometimes grow seven or eight tons to the acre.

Remark. What has been your experience with alfalfa on bench land by simply discing it and not plowing?

F. B. Linfield. I have never had any experience in that line. The land I have used has usually been cropped. I might say in starting alfalfa on unirrigated land, it is necessary to have the land in good condition. It is not well to start it after a very dry winter since there is very little water stored in the soil. If you have a wet winter and the land is well broken up and cultivated I believe your alfalfa will do very well. My plan is to get enough moisture in the soil to get a good stand established the first season.

Remark. Have you seen alfalfa grow on land that is not irrigated?

F. B. Linfield. Yes, both in Montana and elsewhere.

Remark. We sowed some land that way and it seems to be coming up.

Remark. Bench land that is too moist for grain would be too moist for alfalfa.

F. B. Linfield. Land where seepage water is coming up is not good for alfalfa. Any place where it comes up alfalfa will kill out.

Remark. In such a place you will get a good crop for a year or two and then it will kill out.

Remark. How would clover do?

F. B. Linfield. Alsike clover grows in moist places in Gallatin Valley nearly four tons per acre in two crops. It will grow in quite moist places. Under these conditions try alsike. Considering the question of relative fertilizing power I would prefer clover for an enriching crop. You will find it eqaully as good for feeding stock, either cattle, sheep or hogs. It perhaps will not give quite as large a crop per acre as alfalfa, but it is a good feed and grows well in this country.

Remark. How do you advise starting alfalfa?

F. B. Linfield. On dry land I would not grow it with another crop. It is better to seed the crop alone on well prepared land. Cut it down after it has grown about six inches and let the hay

remain as a mulch on the ground. On dry land I would not take any crop off the ground the first season. The mulch that is left on the ground catches and retains snow in the winter and thus makes the land more moist. I have found that it grows particularly well on a loam, a soil that is between clay and sand. If you have watered land, alfalfa will grow on a sandy soil but with sand it will dry out too much on your bench land. Adobe soil is a heavy clay and liable to be wet.

Remark. How is a gravelly clay soil?

F. B. Linfield. It is alright for alfalfa if it is well watered. Alfalfa needs a deep rich soil with water table well down. On a gravelly soil you can give it all the water necessary without danger of drowning.

W. W. Gambel. The question of the depth at which you find water is very important here. If water comes to within four feet the alfalfa will do well under those conditions.

F. B. Linfield. If it comes up only for a short time in the spring it is alright, but if it is permanent I think the alfalfa will kill out in a few years.

W. W. Gambel. Then there is the matter of stagnant water in subsoil. The question whether alfalfa grows better where the water is stagnant or if flowing is very important.

F. B. Linfield. If you have moving water it is better than stagnant water but even then I would not be sure of alfalfa growing.

W. W. Gambel. There is another question of raising alfalfa on sod. Mr. O'Donnell of Billings, considers that it can be successfully done, but it takes about two or three years to get a good stand. Our experienc has been that it comes up. This is by discing. It strikes me that conditions in Utah are somewhat different than those in Montana for alfalfa.

W. W. Gambel. Did you ever have any experience with orchard grass.

F. B. Linfield. Yes, I have used it for meadow and pasture and have found it makes a very good pasture. Mixed with the alfalfa it makes very good feed. It matures quicker than timothy hay. Alfalfa grows in bunches, so does orchard grass. It certainly makes a good feed for stock and an excellent pasture and is in some cases preferable because it gives a variety.

Remark. Do you consider any of the tame grasses better than the blue joint?

F. B. Linfield. If blue joint does as well as I have heard it did here, I do not know of anything that does better. Any grass that will produce four tons of feed per acre is well worth consideration under irrigated conditions. How does bleu joint do here?

Remark. I do not think it will make a ton an acre.

Remark. Three-quarters of a ton is a fair stand.

F. B. Linfield. If it will not do better than that it is not worth working with, because we have other fodder plants that will yield very much better.

Remark. What I have seen of blue joint here is if you take dry land and seed it down, the next year it will give a pretty good crop. It may run for a year or two but the second year it is a little less, and the third year still a little less. After three years it will not average half a ton.

Remark. The best meadow I know of is timothy sowed with blue joint and disced in. You can also mix red top with it.

F. B. Linfield. Did you every try orchard grass?

Remark. No.

Remark. I have one meadow of blue jonit that produces three tons per acre but it is well taken care of.

Remark. I have cut from 60 to 75 tons from a meadow of 60 acres for four years. It has had no care to speak of, but the land is watered.

F. B. Linfield. I believe you could do nearly twice as well with timothy. Disc it in. Timothy will not stand pasture as well as some other grasses.

Remark. I think here with us it will stand pasture better than any other grass I know of. I have watched a piece of timothy ever since I came to Montana five years ago and it had been irrigated at that time once or twice, but it was from 45 to 50 feet to water. It was left outside of a fence and cattle and sheep ran over it. Every year I saw a number of head mature. Last year it was plowed up and put into oats and even yet most of it is timothy.

DISCUSSION AT CHINOOK.

F. B. Linfield. How many of you are growing alfalfa in this country?

Remark. Quite a few.

F. B. Linfield. Is it successful with you?

Remark. Yes, generally.

F. B. Linfield. What is the yield?

Remark. About four tons for three cuttings.

F. B. Linfield. You say it winter killed last year and again some this winter.

Remark. I have had alfalfa for six years and I have had it winter well although it killed some this winter.

F. B. Linfield. To what do you attribute it?

Remark. Letting it go into winter quarters too dry.

F B. Linfield. What was the latest date of irrigation?

Remark. After the last crop.

R. H. Clarkson. I saw a field a year ago this spring and the dryest and highest ground was alright, but that on the wet land was killed.

F. B. Linfield. Is the land pastured bare?

Remark. It is pastured quite closely.

Remark. A year ago last winter very little snow was on the ground and alfalfa killed badly.

F. B. Linfield. An inch or so of snow on the ground is as good as several blankets.

Remark. Another reason why alfalfa kills I think was on account of the dry weather. On examination the roots looked very much like parsnips without any moisture after they had gone through the winter.

W. M. Wooldridge. Isn't it a fact also that pasturing excessively in the winter or early fall is injurious?

F. B. Linfield. Tramping or breaking the crown or root is likely to do it injury. It will not stand pasturing to the same extent as other grasses. The greatest harm is from too close pasturing.

Remark. Mr. Lohman has a piece where sheep were driven across and it looked perfectly bare, but now there is as fine alfalfa there as any.

Remark. Sheep going across the ground would pack it so that it will be protected.

F. B. Linfield. Alfalfa will grow on land strong with alkali. If it has a white crust it is doubtful if you can do anything with it.

John Lusc. Do you think there is any difference in varieties of alfalfa?

F. B. Linfield. Yes there is. First there is Turkestand which is different from the other.

John Luse. How does it do?

F. B. Linfield. It does not winter kill as easily as the other.

John Luse. How do the other varieties do?

F. B. Linfield. The different varieties. Some are able to stand cold and drought better than others. There is a broad field in Montana in originating new varieties adapted to the Montana climate. The Turkestand has the reputation of standing winters. Seed, however, is very expensive, $35 per hundred pounds, on account of the small supply and the large demand. Can you grow alfalfa seed here?

Remark. I think so.

F. B. Linfield. Has any one ever tried it?

Remark. I made an attempt at it but cut the first crop and it was not sufficiently matured.

F. B. Linfield. Turkestan alfalfa is said to ripen earlier than the other varieties.

Remark. In growing seed would you advise cutting the first crop and depend on the spring moisture for irrigation?

F. B. Linfield. Yes, unless you have a very dry spring. Do not put too much water on land if you are going to raise seed. It will produce leaves and stem and no seed if you do. I believe you ought to be able to grow seeds here.

Remark. Along our ditches where the mower does not cut quite a quantity of seed grows.

F. B. Linfield. You have to be guided by your own experience in these matters. I would not put too much water on it however.

Remark. When you grow a crop for seed you advise watering early and not again in the season.

F. B. Linfield. Yes, that is what I would do. How is the yield here?

Remark. Two to 400 pounds per acre. 300 pounds is probably an average.

W. B. Harlan. For raising seed do you have to let the hay get ripe enough so it is no good?

F. B. Linfield. You can use it for feeding stock sheep. It is like dust when it comes out of the machine.

Remark. How do you cut it?

F. B. Linfield. I cut it with a mower. I would not advise the use of a binder.

Remark. I have used a binder and it works alright. It does not clog up.

Remark. In speaking of alkali, is there any way to get rid of it.

F. B. Linfield. Yes there is. You can wash it out of the ground.

Remark. Could you do it by putting in a tile drain?

F. B. Linfield. You can do it by draining the land and irrigating in the fall. It is rather expensive; however, if the land is worth it, it is alright. Another way is to manure the land. It will help a great deal if the alkali is not too strong.

Remark. How about sugar beets?

F. B. Linfield. They will grow on land strongly alkali but the beets will contain a large amount of impurities. They are good for feeding purposes, however. Mangolds are better than sugar beets, because they will yield larger and are easier to handle.

Remark. How about dyking and putting a flood of water on

F. B. Linfield. The alkali is liable to come up from below.

Remark. Most of the alkali land is immediately below a ditch of water on level ground. On the high land where we flood and drain it off we are not bothered with alkali.

F. B. Linfield. As the water goes down into the soil it dissolves the alkali. When the reverse process occurs the soil acts as a pump and draws the water up from the lower layers like a lamp wick. It brings the alkali to the surface with it. If you irrigate land so the alkali will go down it will probably come out some other place lower down.

Remark. You will find spots where grass is growing and then spots of alkali and a hundred yards or so from this another spot.

F. B. Linfield. Do you find that these spots increase very much?

Remark. They are usually the higher portions and increase slowly.

F. B. Linfield. There is more evaporation from these points or perhaps the alkali is nearer the surface.

Remark. Does Turekstand alfalfa do as well as the other varieties?

F. B. Linfield. In Utah it did not do as well. If Turkestand is better adapted here it will yield better.

Remark. It is as good as the other or better.

Remark. How about alfalfa on gumbo? Have you ever had any experience?

F. B. Linfield. No I have not.

Remark. I have a field with gumbo on one side and is sandy on the other and I do not see any difference.

Remark. How long has it been in?

Remark. Two years.

Remark. It has not had time enough yet.

DISCUSSION AT HINSDALE.

T. S. Brady. Ladies and Gentlemen: The object of this institute is that the farmers as well as the stock raisers of this country may be benefited by some advice by the gentlemen who are here to-day. Every man present here that is engaged in the stock growing business, sheep raising or farming business knows well that the time will soon be at hand when the range will be limited to a small margin. When that condition confronts the stock growers of Montana they will have to depend more on growing their own feed than at the present time. We well know that there are sheep and cattle being shipped to St. Paul for feeding purposes. If we can arrive at a condition of things so that we can raise alfalfa and feed it at home I think every one will realize that it will not only be a benefit to the farmers and stockmen, but also to all the people all over the country.

Mr. Arnett. I would like to ask what is the best time to seed alfalfa on dry land?

F. B. Linfield. As early in the spring as it will grow. Plow the ground in the fall. Get it in good condition in the spring and then sow it just as soon as the ground is warm enough. Not more than 15 to 20 pounds per acre.

Remark. What effect will freezing and thawing have on seed in the spring just after sowing?

F. B. Linfield. Not a very serious effect. It depends on the severity of the freezing. The amount of freezing I have seen this week would not hurt alfalfa. It can stand considerable.

Remark. In seeding is there any danger of seeding too deeply.

F. B. Linfield. Yes there is, but if you have a good seed bed which is in good condition I do not think it necessary to go down farther than an inch and a half.

Remark. Do you use a brush drag?

F. B. Linfield. To seed by drilling it in without any pressure is alright.

Remark. How about sowing broadcast?

F. B. Linfield. It is alright only you sow more seed that way. It is simply a matter of choice. If the soil is dry you have to put the seed in deeper.

W. M. Wooldridge. Their practice at Chinook is to cover the seed with a harrow after broadcast seeding. They are in the habit of sowing more seed than in the Gallatin Valley from 12 to 20 pounds per acre.

DISCUSSION AT BIG TIMBER.

E. O. Clark. My practice is to disc the alfalfa or to harrow it with a spring tooth harrow in the spring just after the alfalfa starts to grow. Cultivation in the fall will weaken and tend to kill out the alfalfa.

The first alfalfa sown in the Yellowstone Valley was sown in 1888 by Mr. Vestal, and it is now the best piece he has. I seeded a piece in 1889 and it is also very good. The alfalfa does not freeze out to any extent.

There is a little alfalfa seed grown in the valley, enough to show that it may be grown successfully. In this valley leave the first crop for seed, but do not irrigate the ground. I do not think that it would be possible to cut an early hay crop and then get a crop of seed.

Question. Is it safe to pasture alfalfa?

Answer. I could not guarantee immunity from bloat in pasturing on alfalfa, but I believe the danger may be reduced to a minimum by starting the cattle on the pasture carefully, in the spring and then keeping the animals in the pasture day and night after that time. A mixture of grasses with alfalfa makes a safer pasture. On such a pasture, one-third of which was alfalfa, I pastured cows for 8 years with practically no loss.

The best cure for bloat that I have used is to give a drench of a tablespoon of turpentine to one quart of linseed oil, if given soon after the animl starts to bloat. In the later stage of the bloat the only cure is to stick the animal on the left side at a point four inches in front of the hip bone and four inches below the loin. The trocar and canula is the best instrument for this, and is an instrument every farmer should have on hand.

Question. What do you think of Turkestan alfalfa?

F. B. Linfield. The Turkestan alfalfa was introduced from Asia some years ago by the Department of Agriculture at Washington. To the casual observer it does not differ in appearance

from the ordinary alfalfa plant. As originally introduced the variety possessed greater drought resisting power and greater hardiness than the common variety. These are qualities which should make it valuable to many parts of Montana. Whether the American seed of this variety grown under more favorable conditions yet possesses those advantages I cannot say.

I am inclined to think that there is something to be done in growing alfalfa seed in Montana. Reasoning from analogy, the tendency would be after a few generations to produce a hardier type of plant, better adapted to Montana conditions. The evidence at hand seems to show that if the field is properly handled, alfalfa seed may be profitably grown in several localities in Montana.

Question. Will Turkestan alfalfa stand the wet?

Answer. No, it is a drought resister, not a water resister.

Question. How would you handle alfalfa on alkali soil?

F. B. Linfield. Alfalfa will probably thrive on soil stronger in alkali than any other of our forage plants. In this however, it is presumed that the land is well-drained and that the water table is several feet below the surface. On soil so wet that alkali somes to the surface and concentrates there, the alfalfa will kill out.

BREEDING WITH A PURPOSE IN VIEW.

By John W. Pace, Helena, Montana.

In the discussion of a topic which carries so much interest to the stockman and farmer generally, it is well to leave the path of theory and go into local history as a basis for our assertions. Few feeders succeed until they combine the theory with the practice, taking the two along, and using the one as a sort of buffer for the other. A bald theory, unless backed by careful and painstaking practical study, is one of the profitless experiments of the breeding world; while on the other hand, a conscientious blending of theory with practice usually points the road to success.

One of the first contentions of the small stock farmer is that pure-breds are chiefly for the benefit of the rich, who have a superabundance of feed and hired men, and that the poor man can not afford to give the purebred the care it ought to have or that the investment warrants. That is one of the fallacies of the breeding world, for the item of care is identical in all stock worth keeping, and there is no added item of expense unless there is fitting for show.

The contention is heard that the investment in purebreds is too great, and that the prices asked are often out of proportion to the values. That this may be true in some cases must be admitted, but as an abstract assertion it is erroneous. The value of a purebred breeding animal is arrived at by the utility of the strain or strains that are combined in the animal and shown by its blood lines and the individual. I do not believe that a man with an average bunch of cows can afford to breed them to a sire that he does not value upward of a hundred dollars. I do not believe under ordinary conditions, that any of us ever saw a $50 bull that was worth the money, unless he would weight it on the scales and make it for beef.

On the other hand we see men every day using sires that cost from two hundred to one thousand dollars who are better pleased and are reaping better returns for their cattle product than the men who are using cheaper grades of breeding animals.

There is but one final test to the value of blood in beef cattle and that is the butchers' block. When your cattle go over the plank at any of the larger stockyards they go at a price that the judges of beef place upon them. That price is based upon the quality and the quantity of beef the animal will cut in the market of the consumer. The buyer in the stockyards will not ask you how beef steers are bred, he does not need to ask you. The fact will show in the animals, and the good back, heavy loin and well sprung rib will show it too plainly.

The old theory that fat is the best color still holds good to a great degree and always will in the beef world, but the cost of that fat is the portion of the question to which the breeder and the feeder must address himself. He cannot afford to sell meat at four cents that costs him five cents to make, and it is under this head that the breeder comes face to face with the economic feature of the question and the profit winning part thereof. Here is where the divergence between the "scrub" and the good grade comes in, and right there is where the breeder and seller must do his thinking.

I do not propose to waste the time of those who have, in many cases, been in the business as long as I have lived, by telling them or attempting to tell them what constitutes a beef animal of the best type; they see them as I see them every year on the market and the type is not a theoretical one, but one that has long ago reached a hard and practical standard.

I believe that no herd ever remains at a fixed excellence. It either retrogrades or advances. The infusion of new blood advances it, while the attempt to let good enough alone always results in a backward slide.

There is no hard and set rule for breeding any sort of animals. The observation and study of each class of cattle and each herd will give its owner the cue to improve it. At no time in the cattle history of Montana has there been a more forcible illustration of the discrimination of the buyer than during this fall. Thousands of half-ripe cattle have gone east and been sacrificed to the men who place them in the feed lots and who will gather what profit there is in the transaction. I need merely to remind you that the herds that have been bred up were the only ones in Montana that this year received fair prices on the Chicago markets.

We have all heard men say they did not care whether an ani-

mal had a pedigree or not—that pedigrees were expensive, etc. Now, for one, I always feel a little better satisfied if I know how a good animal is bred. I believe we all do. I believe that there is some attraction in knowing the origin of a good animal, its dam, its sire, and its breeder. I know, too, that the animal with a double pedigree—the one carried on its back and the one on the written records—always brings an added price. I believe the written pedigree is always an aid to the seller.

The subject can hardly be passed without a moment on the horse situation in Montana. If ever the stockmen of a state paid a heavy penalty for haphazard breeding, the owners of horses in this state have done so within the past few years. When the slump came in horse prices there was a stoppage of breeding. Men allowed their horses to run wild, to bred promiscuously, to inbreed, and to taper gradually to what we call the cayuse. It does not take many generations for the grade to go back to the nondescript. It took less than ten years in Montana for the entire horse product to change.

There has been for the past three years a demand for the useful grade horse, weighing from 1,200 pounds upward, and he is at a good price to-day. I need only remind you of what many of you know that the buyers of horses for importation, coachers and carters and all round work and road horses, have been unable this year to obtain fifty per cent of the demand. There is at this time a remarkable dearth of good horses, and Montana should, under ordinary conditions have reaped a golden harvest the past few years.

We are gradually reaching the point of the farmer-stockman. We are no longer a range state, strictly speaking. Our breeding operations should now begin on better lines, for we have reached the state where nearly every man must own his pasture lands. Under this condtion the old excuse that a man would not buy good sires because his neighbor (who used the same range) would not, no longer holds good. That excuse has been largely at the bottom of our difficulties in breeding lines. It has been well founded in very many cases, as there are men in this world who will not buy blood until they have to or so long as their neighbors will do so. That is all wrong, and we must have a better system under this head if we progress in the lines for which this great state is so well fitted.

Just recall the eastern state from which you came, and think

over some things that happen there. No farmer of the eastern states declines to improve his stock because his neighbor holds back. On the other hand he will buy good blood on his own account and in a few years he is selling it to his neighbor, who has learned by observation the value of going ahead. Every ten miles in Nebraska has a good service stallion. He is in nine cases in ten owned by a stock company composed of farmers. They are willing to pay $1,500 to $2,000 for a good imported horse. The result is that every farmer in the older communities counts as a selling article every year a good colt and often a half dozen. If these things can be done where land is worth a hundred dollars an acre why can it not be done here?

There can be no doubt that good Shire or Percheron or Belgian stallions scattered through Montana, a hundred of them, would in a few years work a change in the resources of the average farmer. Montana forage and altitude gives to her horses the lungs, the staying quality and the vigor required and which is admired throughout the world. Mingle this with good blood, and I assure you that the horse product of this state will always bring a premum over that of any other community. It must be so. The superiority of our horse product is established everywhere, and the effort at home is all that is necessary to make this a great industry.

The attention of the farmer-stockman is called to this matter of horse raising on an improved scale, and the suggestion is made that some study be given the opportunities in this field.

No man plants a crop without a definite idea of what he intends to raise. He buys seed with a view to producing a certain variety. He plants with a plan, he reaps as he plants. This rule should apply to stock breeding even as emphatically as it applies to planting. He sends for new varieties to improve his revenues; he does not buy mongrel seed; he wants a pedigree, so to speak, with the grain he buys for seed; he buys with the guarantee that it is such; he makes his purchase with a view to reproducing it as good or perhaps improving thereon. But we often see that same man so inconsistent in the livestock department of his work that he breeds haphazard and questions the wisdom of the neighbor who outlines a plan, buys good blood, cares for it and breeds to a purpose.

Farming and stock raising is a business. All business requires a system, or it fails. The farmer and the stockman without a system works at cross purposes. Like a ship without a rudder he wanders to unknown ports, with a doubtful cargo.

DRAFT HORSE RAISING.

By Dr. W. C. Orr, Dillon, Montana.

The principal breeds or races of draft horses are Percherons, Clydesdales, and Belgians. They are again called by different names in their respective countries, according to the district or counties in which they are bred. As in France, they are known as Percherons, Bretons and Baulounias. The name Norman is one used in America for almost any kind of an old grey horse, and it is comparatively unknown in France. In England they have the Lincolnshire, Yorkshire and Suffolk, all registered in the Shire stud book.

The Clydesdale comes originally from Scotland, but they are also bred in Canada and are imported into the United States and registered in the Clydesdale book.

The Percheron comes from La Perche, France, and is the superior of all French horses. He is registered in the stud book of France. At a meeting of the American Percheron Horse Breeder's Association held at Chicago, November 15, 1883, it was unanimously resolved to exclude all animals from registration in the Percheron stud book of America that had not been previously registered, together with their pedigrees, in the Percheron stud book of France. This action was taken in order to establish a basis from which any breeder should know that he was getting a pure bred horse.

This is, or rather, should be, the necleus or starting point for all breeders. To know to a certainty just what they are breeding. Whether he is a full blood, registered horse, or a grade. As like produces like, such will be the offspring of the horse.

The next thing to be considered by breeders is the individuality of both the mare and the horse. I would sooner breed to a good individual without pedigree, than to breed to a poor individual with a pedigree as long as the moral law. But do not mistake me; you must combine the two—pedigrees and individuality.

In regard to the different breeds of draft horses the choice is

merely the breeder's opinion or fancy. Often, in some measure, the section of the county, the work and demand for the different types is the important factor which decides which type of draft horse should be raised.

For my part, I prefer the Percheron as I deem him the best all round horse of any of the draft breeds. As a rule he has more action, more style, more ambition, more courage, and he has better feet for our dry climate. Another factor in his favor is that he is longer lived than any of the other draft breeds. His disposition is a point which cannot be overlooked. Most of them are very docile, easy to break and very intelligent.

Montana has been and is yet, with a little closer handling and feeding, one of the best states in the union for the horse. The ranges, the oats, the altitude, the water and the dryness of our climate are all important factors in the production of the best bone, muscles, lungs and feet and there is not another state in the union that can compare with Montana as an ideal horse raising section. Just watch some buyer from the East or middle states examining our horses. They examine their feet, eyes, legs, run them to see if they are "windy" as they call it. You do not see any Montana buyer do this; he is not used to looking for such things.

Now that our ranges are getting pretty closely grazed off, we will have to breed fewer in numbers and better in quality. Better have one good stallion than a dozen poor one's and don't get one of poorer breeding than full blood. The best are none too good. If the mares run at will upon the range, get them in and breed them in such a manner that you will know that the colts are the produce of your horse—don't guess at it. Then, when the feed becomes dried up and covered with snow, bring them in and feed them. If you don't have any grain to feed them, give them hay and plenty of it, and they will thrive throughout the winter in a manner which will surprise you.

We are now feeding 150 head of weanlings and yearlings and some of our best two and three-year-olds. While the weanlings lose a little in flesh the first ten days or two weeks after they are taken from their mothers (which might in a measure. and especially so when fed on a smaller scale be avoided), they soon get on full feed and the gain thereafter is quite noticeable. Especially is this so in the two and three-year-olds.

We find that young stock will do much better on alfalfa than

on any of the other hays. When fed throughout the winter on this feed they are in good condition by the time green grass comes in the spring and they are in a shape to continue growing right along ,not having experienced the stunting period which comes to all colts which are compelled to rustle their own feed during the winter season.

And, now we begin to realize that the bicycle and automobile have not replaced the horse, but the simple factor we have to contend with is the supply and demand. Especially is this so among the better breeds and the increased demand has created a decided stir in horsedom. We will probably from now on be able to get a profitable price and a ready sale for all the good horses we can raise. The cayuses like the Indian and the cowboy are "has-been"; the good horse is an "Iser."

THE LIVE STOCK INDUSTRY IN MONTANA.

By F. B. Linfield, Agriculturist Experiment Station.

When the first white settlers came to Montana they found the fertile valleys and foothills and in some places the hills themselves covered with waving grass. Here the buffalo thrived and got fat and countless thousands roamed over the hills. The white man's rifle soon exterminated the buffalo and his place was taken by the white man's cattle. In those early days cattle were few and the feed plentiful and as the stories of the wonderful meadows and the great possibilities of the cattle business travelled eastward; others thought to enter in and reap some of the wealth. The herds of cattle increased and the best ranges got too small. Sheep came and the whole country, valleys, foothills and mountains were one immense pasture. The settlers also came, first but few, then by scores and hundreds and spread themselves over the fertile valleys. They are yet coming and the range country is being pushed back further and further into the broken and hilly country. All these causes soon led to crowding on the range. The livestock increased faster than the feed. The close cropping and the continuous tramping, destroyed the favorable conditions for the retention of moisture and reduced the annual

crop; in some places actually destroyed the sod and the soil being unprotected has been washed away. These conditions brought hard times to the livestock on the range and during a dry summer and an unfavorable winter thousands of cattle and sheep died. These changes and experiences have brought forcibly to mind the fact that the conditions of the past are passing away and that new methods of practice must be followed to meet the new conditions.

For many years and even yet in some places, it was thought that only a few favored valleys in Montana could be farmed to any profit. It is now being generally recognized that with soil and climate so favorable, and the immense amount of water flowing through and out of the country that many irrigation enterprises are possible and could be made profitable. Again large areas are being taken up, fenced and farmed without irrigation. In traveling over the state I have been impressed with the great possibilities in this direction. The rolling hills and the foothills around Galaltin Valley, in Madison County, around Great Falls, in the Judith Basin and along the line of the Great Northern railway to the north, are being rapidly taken up and farmed. The adjoining lands too rough for cultivation are being fenced for pasture and properly cared for. In many places it looks as though directly or indirectly the range is going to be not the main consideration but an adjunct to the farm. The range controlled and properly cared for will furnish the cheap summer feed. The ranch will provide feed that will keep the livestock growing all winter and in the end much more livestock will be kept than even in the old days of the wide open range.

The days of the cattle baron are largely past in Montana, not that there are many less cattle but they are divided among more owners. Herds of a few score or a few hundreds make up the bulk of the cattle holdings. The distribution of the holdings is going on rapidly and with it an increase in the number and quality of the cattle. In the old days 15 to 20 acres were needed to support one cattle beast; with irrigation four to five tons of alfalfa or clover may be produced on one acre and the same will keep a steer for nearly a year. Over large areas, the bench lands, without irrigation if properly cultivated, will often produce from two to three tons of grain-hay per acre and in favorable localities I have seen two to two and one-half tons of alfalfa cut from such

land. These facts promise much for the future of the livestock industry.

With the change from range to ranch, or rather a combination of ranch and range, other changes are necessary. In the early days with its abundant feed, cattle were grown till they were three, four or even five years old, and they could be fattened and sent directly from the range to the shambles. It is different now. The steer goes into the fall in fairly good condition but for October and November gains but little. During four to five months of the winter he merely exists, frequently losing from 100 to 200 pounds in live weight. It takes from one to two months to recover from the winter hardships so that not more than three to four months are left and in this time all the gain of the year must be made. It is not at all to be wondered at, therefore, that under those conditions it takes four to five years to get a steer to a marketable weight.

Combining the ranch with the range, however, the first endeavor has been to feed so as to maintain the weight of the animal. A few are now doing better than this and feeding during the winter so as to make gains. The animals thus come out in the spring, larger, stronger and much better able to use the spring grass, and as good weights are obtained in two-year-olds as formerly in three-year-olds. In the change from range to ranch which permits of better care being taken of the cattle, the Montana farmer has not been slow to recognize the value of pure-bred blood. Montana has a Registered Cattle Breeders' Association and some very fine pure-bred cattle are raised in the state. The tendency is towards better stock, and better feeding and in a few years the Montana farmer will be marketing two-year-olds from the farm with as large a margin of profit as he obtained from the older animal from the range in years gone by. Under the new system the losses are practically nothing, and the speculative element is largely eliminated.

Another change which seems to be going on in the range country is a substitution, in a large measure, of sheep for cattle. In the old days, cattle had complete possession. The sheep have gradually, yet surely increased and spread themselves over the land. They thrive where cattle would starve; they reach places inaccessible to cattle but have no objection to the best feed to be had. Montana has about 5,000,000 sheep within her borders—more than any other state in the Union. The annual crop of

wool and lambs is valued at millions of dollars. Even for sheep, however, the range has been stocked to the limit and the era of expansion must cease.

It would seem that the sheep are a permanent fixture on the range, especially in the bad-lands country and in the more distant ranges. There are millions of acres in the state which can never be farmed, but they will furnish pasture which sheep can best turn into money. Under proper regulations it will pasture sheep for ages to come. Here again changes are going on. It will appear that the flock of the future will be largely a ewe flock, of a kind and quality adapted to the range country yet possessing good mutton quality. The increase of the flock not needed to maintain its quality and size will be put into the market and sold largely as feeders.

The farmers also will come in contact with these sheep men. At present thousands of dollars are being sent out of the state for pure-bred bucks to maintain the quality of the range flock. Many times the amount might be spent with advantage. In the course of time on the Montana farm will be produced the bucks which will be needed on the range. Montana feed and climate will produce as fine quality of sheep as may be found elsewhere and with experience the breeders will not be less skillful. The home grown sheep being acclimatized will do better on the range than the imported animals.

Again the Montana farmer will take many of the surplus lambs from the range and fit them for market. This industry has already attained large proportions. Probably 200,000 sheep are being fed in the Yellowstone Valley this winter, over 50,000 are being fed in the Gallatin Valley. Large numbers are also being fed in the Beaverhead Valley, and other sections of the state, notably in the Milk River Valley, along the Musselshell and in the Judith Basin are starting in the business. Alfalfa, clover, and more or less of the native grains are being fed and with very satisfactory results.

The Experiment Station is devoting its attention to solving the problem arising out of this change from range to farm conditions. Extended study is being made of the value of Montana fodder and grains in the growing and fattening the livestock of all classes. While we are only beginning this work the data at hand goes to show that with Montana feeds, cattle and sheep can be fattened rapidly and economically. Last winter the Station

fattened a bunch of three-year-old steers that gained 2½ pounds per day for 111 days, on a ration of clover hay and five pounds of grain a day as a maximum. The ration cost but little over four cents, for each pound of gain made, not at all expensive gains for a three-year-old steer.

Experiments are also in contemplation looking towards the determination of the cost of producing the young animal on the farm, and to demonstrate more fully the value of improved blood in the farm herds.

Montana offers one of the best markets in the United States for dairy and poultry products and the opportunities for their profitable development are most promising. The Station has already started experimental demonstration looking to the encouragement of these lines of work.

In our sheep-feeding work the experiments of the past winter fully demonstrate that Montana stock and Montana feed when in proper combination can give a finished animal that will command the top of the market, aye! even a premium, in competition with sheep fattended in any other part of the United States. A carload of sheep, half lambs and half wethers, fattened on the station farm, sold on the Chicago market, the lambs for $7.25 per 100 pounds and the wethers for $6.00 and 100 pounds. This was the highest price paid for the year to this date (1st week in March, 1903) and some 25 cents above the market for that day.

We are moving along the problem outlined by the call of the National Livestock Association,—an experiment on the possibility of fattening and finishing western livestock on western feeds and making them equal to the best corn fed, and also how to do this at a profit to the feeder under average conditions. It is an experiment I am following up with a great deal of interest and I do not think the western feder has anything to fear from the results.

FEEDING SHEEP AT THE MONTANA EXPERIMENT STATION.

By F. B. Linfield, Agriculturist Experiment Station.

During the winter of 1902-3 the Experiment Station fed a carload of sheep, half lambs and half wethers. They were an extra fine bunch of sheep, grade Shropshire of good size and quality. They had the run of the Station farm for one month and had good feed so that they came into the feed lots in excellent condition. They were started on feed on the 22d of November and the grain ration was started on Dec. 1st, a month was taken to get up to a full grain ration of one pound per sheep per day.

The sheep were divided into ten lots, five of lambs and five of wethers. All were fed the same hay ration, but different kinds of grain. Lot one had wheat screenings, lot 2, wheat; lot three oats; lot four, barley; and lot five mixed grain. The sheep were fed for 95 days.

The result may be discussed from two points of view, first for the lots and second for the whole lot of sheep. For the lambs the wheat screenings proved the cheapest and most efficient grain ration. Each lamb in the lot gained 27¼ pounds at a food cost of 4.04 cents per pound. For the lot it took 7¾ pounds of clover and 2.8 pounds of grain for one pound increase in live weight.

The ration of mixed grain and clover gave a return very close to the screenings, viz: a gain of 27 1-8 pounds per lamb at a cost of 4⅓ cents per day. The food cost of one pound of gain in live weight was 7 pounds of clover and 2.9 pounds of grain.

The lot fed wheat gained 25⅔ pounds, the lot fed barley gained 24⅓ pounds and the lot fed oats gained 20.9 pounds during the feeding period. The cost of each pound of gain was wheat-fed lot 4½ cents, barley fed lot 5 cents, and oats fed lot 5½ cents for each pound of gain in live weight. The lot fed oats required the most food for each pound of gain, viz: 9.6 pounds clover hand and 3 2-3 pounds of grain.

For the wethers, the lot fed on barley and clover gain the most, each wether on this ration gaining 27¼ pounds. The cost of

each pound of gain was 5⅓ cents and it required 11.9 clover, 2¾ pounds of grain for each pound of gain in live weight.

The lot fed on oats and clover gained 23.9 pounds and cost 6.1 cents for each pound of gain. 13½ pounds of clover and 3 1-5 pounds of grain were required for each pound of increase in live weight.

The lot fed on wheat gained 23 pounds and cost 6¼ cents for each pound of gain. The food cost of one pound of gain was 15 pounds of clover and3 2-3 pounds of grain.

The lot fed screenings only gained 21 pounds and the lot fed mixed grain only 18 pounds per wether. These results are directly the reverse of the results with the lambs,—the growing animals, where the screenings and mixed grain gave the fastest gains. On the mixed grain ration the wethers ate 15½ pounds of clover and 4 1-5 pounds of grain for each pound of gain, made at a cost of 7 2-3 cents.

Considering next the whole lot of lambs and wethers. The 109 lambs gave an average gain of 25 pounds per lamb in the 95 days. The cost of each pound of gain was 4½ cents and it required eight pounds of clover and 3.1 pounds of grain for each pound of gain.

The 112 wethers gained on the average 22½ pounds each or 2½ pounds less than the lambs. The cost of one pound of gain was 6.3 cents or 1.8 cents more than for the lambs, while it took 13½ pounds of clover and 3.4 pounds of grain for each pound of gain on the wethers or 5½ pounds of clover and 3-10 pounds more grain for each pound of gain in live weight. The lambs would appear to be much the more economic feeders.

The Returns.

The lambs cost us $1.80 each or 2.57 cents per pound. The total cost of the lambs was $196.20. The cost of the food given them was $125.40 making a total cost of $321.60.

Had we sold the lambs at 4½ cents per pound live weight, the average price paid in Bozeman last year they would have returned $456.10 or $155.50 profit, equal to $1.32 on each lamb.

The wethers cost $2.80 each or 2.25 cents per pound. The total cost of the wethers was $311.60. The cost of the food was $156.72 making a total cost of the wethers $468.32. Had the wethers been sold for 4 cents per pound they would have returned $654.28 or a profit of $185.76 on the 112 head or $1.66 on each. This was a larger return on each wether than on each

lamb, but in proportion to the amount invested, the lambs returned 73 per cent profit and the wethers 59 per cent profit. In other words while each wether returned a larger profit than each lamb, yet on the same amount of money invested in lambs as in wethers the lambs returned 14 per cent more profit.

These sheep were shipped to Chicago and sold. The lambs brought $7.25 per 100 pounds and the wethers $6.00 per 100 pounds live weight. At these prices the profit on the 109 lambs was $255.50 or $2.34 each and the profits on the 112 wethers was $314.22 or $2.80 each, a profit of 130 per cent on the lambs and 100 per cent on the purchase price of the wethers. These sheep sold at the top of the market in Chicago, in fact commanded a premium, both the lambs and the wethers selling about 25 cents per 100 pounds above the quotations for the day.

Live stock in shipping always shrink more or less, depending upon the time they are on the road and other conditions. As the average results of three years in shipping to Chicago, lambs have shrunk from 7½ to 8½ pounds on every 100 pounds live weight or an average of a little over 8 per cent. The wethers have shrunk about the same.

The expense of shipping to Chicago on the average of three years is about 79 cents for each lamb and $1.16 for each wether.

Combining these two items of expense in shipping, the shrinkage, and the freight, commission, etc., and deducting from the price received for the sheep we get the net return for the sheep at Bozeman. On this basis we receivd $5.29 pr 100 pounds for the lambs and $4.78 per 100 pounds for the wethers at Bozeman. As we received $7.25 per 100 pounds for the lambs and $6.00 per 100 pounds for the wethers, this would indicate that the total cost of shipping was $1.68 per 100 pounds for the lambs and $1.22 per 100 pounds for the wethers.

There are a few points about this test that should be encouraging to the Montana feeder. While we cannot always count on the same amount of profits as is recorded in this test yet our experience shows that for the past three years the profits have been substantial and occasionally very good indeed.

There is a large yearly increase of the range flocks which must be marketed as feeders. The experience of the past shows that there is profit in raising sheep on the range. These tests indicate that there is good profit in feeding the yearly increase on the farm.

Again the Montana grown and Montana fed sheep commanded the very highest market price in competition with the best grown and fed in other parts of the country. The Montana farmer with his clover and alfalfa, his wheat, oats and barley, can put as good a finish on the animals as his corn producing neighbor to the east.

These sheep were fed outside in the yard, but a small storm shed was provided as a shelter. The climatic conditions in Montana are favorable to the sheep doing well with a minimum outlay for shelter.

Question. We have been thinking of raising sheep on a small scale to avoid cutting hay. What do you think about it?

F. B. Linfield. I believe the same contrasts will hold good between the sheep and cattle on the farm as is true on the range when a man likes that kind of stock. Sheep in proportion to their live weight grow more rapidly than cattle and gain more economically. They are ready for the market at an early age and produce two crops in the year, wool and lambs. For the most of the year the sheep will gather their living from what generally goes to waste on the farm. They will fatten on the stubble fields in the fall and as on the range will thrive on weeds that cattle refuse.

Even from a mutton and wool standpoint I believe the sheep on the farm will pay as well as any other meat-producing animal, provided the proper stock is selected, but there is another opening for the sheep business on the farm and that is in supplying the range flocks with the high grade and pure-bred rams needed to maintain the quality of the range flocks. I am fully pursuaded that the climatic conditions and the fodder we have are eminently adapted to producing sheep of the very highest quality; animals able to compete in every way with the eastern flocks.

Question. What do you think of goats?

F. B. Linfield. I am not an expert on goats. From observation and inquiry a few things seem to be fully established. There is not nor should be any conflict between the sheep and goat industries. The goats (Angoras) thrive on hilly and brush land not adapted to sheep. The Montana climatic and other conditions seem to give a very superior mohair. Leaving out the pure-bred stock and the brush farm I am doubtful if the goats would prove as profitable as the sheep under present conditions.

WOOL GROWING IN BEAVERHEAD COUNTY.

By T. B. Craver, Red Rock, Montana.

My Friends and Fellow Workers: I am glad to be with you and hope our association may be the means of much mutual benefits. Unionism is the watchword of every calling. Let us keep step in the march of progress.

In addressing you to-day I shall attempt to give you a history of woolgrowing in Beaverhead County. I shall be glad, however, if I may put before you any thought or fact concerning the business of wool growing which may be of interest to you. Let us see at what point to begin. If we are to produce wool we must have sheep, and we ought to have the very best sheep that are adapted to our conditions.

There are many different breeds, and each breed has one or more especially good points, or qualities that one might be puzzled which to choose.

The Lincoln, if size is the only object in view, would be the best. If we wish to raise mutton alone, the Down and the Shropshires are without doubt the best sheep for us.

If lambs are the main object, then the Dorset is the sheep. But my idea is that we should have an all purpose sheep, one that is pre-eminently a wool producer and also a good mutton sheep and one from which can raise from 75 to 100 per cent of lambs. I will say right here that I have raised 100 per cent but once, and that was when I had but two or three hundred head of ewes, but I have heard it said that some of our sheep men around Dillon have raised better than 100 per cent of lambs. But what is the all purpose sheep? In my judgment the Spanish American merino, the Dickinson Delaine, the Standard Delaine, the black-top Merino, or the Rambouilettes are the sheep for our country. It does not matter what we call him, but what we want is a large, smooth merino, free from wrinkles with a compact fleece of long, fine wool, snowy white next to the skin.

I wish to impress upon you the difference between a large smooth merino and a small wrinkly one. Of the first class the ewes are good mothers, the wether are good feeders and as a

rule they both produce a good fleece of long fine wool. While in the second class (or wrinkled ones) the ewes are generally poor mothers, the wethers are poor feeders and the wool is generally short and comes off in shearing in a broken condition. Therefore in purchasing rams, select large smooth sheep, with long, fine compact wool and see to it that the wool is white and silky next to the skin. I don't believe it wise for the flockmasters of Beaverhead county to substitutes, to any considerable extent, and other sheep for the merino, but if, after careful and judicious trial of this kind of sheep, you still desire larger ones, I would advise a cross with the Cotswold; making one cross with the Cotswold and then going back to the Merino.

My reasons for the above—first, the Cotswold is a very old breed, having been known longer than any other breed and it naturally follows that it is a very strong, hardy sheep. 2nd, it is a large and good mutton sheep. 3d, it has a good fleece of long, strong wool.

You may ask why I so insist on the length of the staple of the wool. I will tell you, that after 20 years of observation, I have learned that the first thing the buyer looks at is the length of fibre—and if the length is alright, and the wool is fairly good otherwise, he is sure to want the clip. Of course, I realize that strong and fine wool is also desirable.

I like the general contour of the Shropshire but after a number of years of experience I am forced to the conclusion that it is not a hardy sheep. He seems to lack grit and succumbs almost without a struggle to accident and hardship. After they are three years of age they develop a tendency to shed the wool from the lower part of the bodies. The staple of the wool is short and the whole fleece more or less fluffy and lifeless.

You may wonder why I lay so much stress upon wool as against mutton. It is because we are comparatively so much farther from the mutton markets than from the wool markets. When I say comparatively, I mean that it costs as much to ship $500 to $800 worth of mutton to market as it does $3,000 worth of wool.

It may be proper to say a word concerning lambing and the summer and winter care of sheep before I close.

If conditions are favorable as to water, brush, shelter, etc., I believe in lambing on the range and leaving the ewes and young lambs as much to themselves as possible. Many of us cannot

do this. I am so situated that a good deal of handling is necessary. In collecting the lambs dropped during the day, I take an ordinary two-horse wagon with top box and haul the lambs home in it, driving the ewes after the wagon, the men who drive the ewes riding horseback. I find this method to be very satisfactory except with the green lambs. It is necessary to mark the lambs that are not dry at gathering time, and their mothers, in order to put the proper mother and lamb together in the pen upon reaching the ranch. At night I keep a man with the drop band and put each ewe and lamb in a stall.

Of course, we all realize the need of good grass, plenty of water and plenty of salt in the summer, if we would have our sheep fat and lambs well grown by fall; and good range and plenty of hay, with more or less salt, if we would have our sheep come through the winter with an unbroken staple of wool and the ewes in shape to raise a vigorous flock of lambs.

A good motto for sheepmen might read: "Winter your sheep in the summer,' or in other words have them fat and vigorous when winter begins and half your troubles are over, and if your ewes are in good shape to take care of their lambs because of your good winter care, a large part of the other half of your troubles will take care of themselves.

SOME POULTRY EXPERIMENTS.

By James Dryden, Utah Experiment Station.

I am afraid my remarks will be discouraging to those of you who see in the poultry business an easy and money-making occupation. I want to dissipate that notion. I am going to discourage you. For three or four years I have been conducting experiments at the Utah Experiment Station, and I assert in all seriousness that it is a business that requires industry. The poultryman must work. I regret to say that there are some other discouraging features about the business; the poultryman must employ intelligence in his work. That is the most discouraging part of it. It would "disqualify" some of us from engaging in the business, as Judge Browning here would say in scoring a black hen on which he found a white feather.

These are the discouraging things—industry and intelligence—in the poultry business. Before any man asks the question, what is the best breed of fowls, he should first inquire into his own breeding. Before he writes to a poultry journal and asks for a recipe for keeping the head lice off his hen, let him first make a thorough search in his own head for some little—sparks of intelligence. If he cannot assure himself of the requisite amount of industry and intelligence he should leave poultry keeping alone and betake himself to some other occupation, such as growing alfalfa or teaching school. Poultry keeping doesn't require a high order of intelligence, but it does require some, and a great many people forget this fact. I may say, by way of encouragement, it is not necessary to know everything about the business to make a success of it. It is not necessary, for instance, to know whether the hen or the egg is more ancient. It is sufficient for all practical purposes that we have both the hen and the egg. It is not necessary for him to know the characteristics of all the breeds of fowls and how to care for each. It is only necessary for him to know well the characteristics of one breed. It is not necessary for him to know a cure for all the diseases to which poultry are subject, but it is necessary to know how best to care for them so as to prevent diseases. It is not necessary either to know the age of a hen by looking at her teeth, but it is necessary to know that when she has reached the toothless age she has survived her usefulness in this world.

A Poultry House.

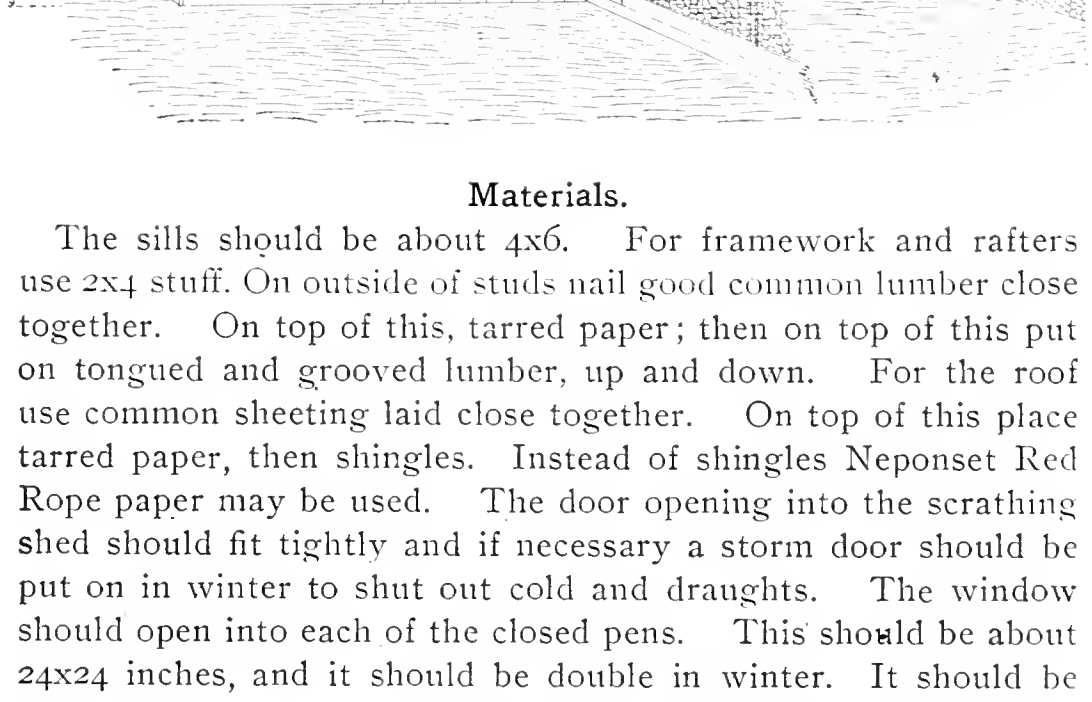
The first thing to do in starting in the business is to provide a proper house for the hen. Some make the mistake of providing the hen and letting her cackle on the dunghill and roost on the dashboard. It is a waste of time to talk to a man about poultry who has not a comfortable place in which to keep his poultry. The first thing then is a comfortable house.

I give here a sketch of one that will answer most purposes. It will be suitable for the farm and also for the town lot. It can be extended to any length desired, or it may be cut in two where only a small number of fowls are to be kept. The dimensions given are for a house that will accommodate about fifty of the smaller breeds of fowls and forty of the larger.

Dimensions.

It is 40 feet long and 10 feet wide, divided into two pens, each 10x20 feet, ten feet of the enclosed part being for the roosting

and laying apartment and ten feet open scratching shed. It is eight feet high at the front and four feet at the back. The outside yards should be about 20x100 feet each. There is no hallway, but there is a door entering from the open shed into the closed part. The partition between the two outside pens may be of wire netting, but there should be about two feet of boards at the bottom to prevent the fowls fighting through the wire.



Materials.

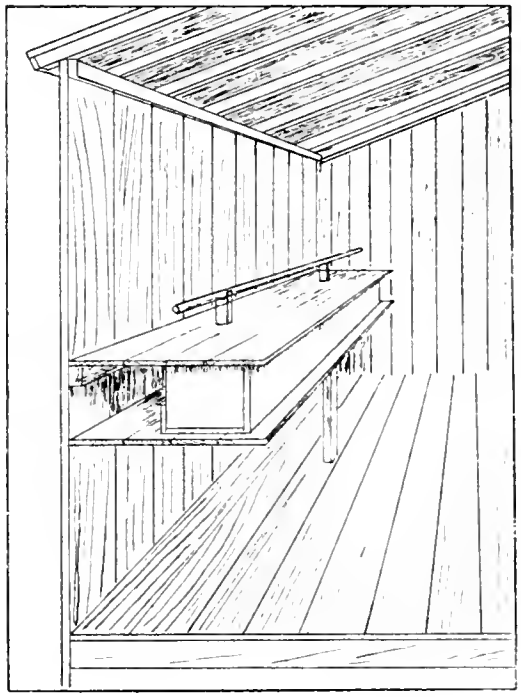
The sills should be about 4x6. For framework and rafters use 2x4 stuff. On outside of studs nail good common lumber close together. On top of this, tarred paper; then on top of this put on tongued and grooved lumber, up and down. For the roof use common sheeting laid close together. On top of this place tarred paper, then shingles. Instead of shingles Neponset Red Rope paper may be used. The door opening into the scrathing shed should fit tightly and if necessary a storm door should be put on in winter to shut out cold and draughts. The window should open into each of the closed pens. This should be about 24x24 inches, and it should be double in winter. It should be low enough so that the sun in winter entering the window will fall on the floor. The end walls of the scratching shed need not be double boarded and papered, but should be wind tight.

In the colder portions of the State it may be necessary to use another thickness of boards and paper in the closed pens. In that case another layer of paper can be put on the studs and tongued and grooved boards on top of that. But probably a better arangement would be to nail sheeting on the studs and put Neponset Red Rope roofing on top of that. That makes a good lining. All lumber in the inside of the building should be planed. This makes it easire to keep the house free from vermin. Instead

of lumber the walls of the inclosed pens may be made of brick with adobe lining. Some claim that this will be warmer and drier.

Nest Box.

One of the important things in the poultry house is the nest. To prevent egg-eating the box should be dark and shallow. The cut shows a good plan. It shows a roosting platform with a row of nests underneath. This plan is recommended by the Reliable Poultry Journal. If intended for Leghorns or medium sized hens, nests 12x12 inches and 7 or 8 inches high will be about right. If for Brahmas or Cochins they should be about 15x15 and 10 inches high. Have some chaff or other good nest



material in the bottom of the box so that there will be less danger of the eggs breaking—a broken egg in the nest is almost a sure way of teaching the hen to eat eggs. The bottom board of the nest shown in the illustration should be hinged to the wall of the poultry-house so as to open upward. The upright which holds the bottom board in position is also on a hinge so it can be kicked from under the board to allow cleaning. The top board or roosting platform should be built on an incline and also hinged to the wall so it can be raised to get at the eggs. The roosting pole should be about six inches above the platform and may be about 1x3 inches, the hens sitting on the wide surface.

Storm Door.

For stormy weather there should be provided a storm door for the open shed. This may be made of oiled-canvas tacked on to a light frame and should be hinged at the top so that it can be hooked up to the ceiling when not needed.

How Much House Space Per Hen?

Having some such poultry house, probably the next question that is most asked is, how much space should be allowed for each hen? Successful poultry keepers recommend keeping them in flocks of from 20 to 50 and giving them from 5 to 8 square feet of floor space per hen.

On this question the Maine Experiment Station has conducted some very interestng experiments, and the results seem very conclusive. In the words of the report: "To obtain data relative to the number of hen that can be kept in a room of a given size, and the receipts from the same, a test was made with fifteen pens of birds, of two breeds. In the Station poultry building were fifteen pens, alike in size and arrangemement Each pen was 10x16 feet on the floor. It was five feet high at the back and eleven high at the front. Each pen had the same amount of window surface in the south side. The roosts, gravel, bone and water dishes and nests were arranged the same in all the pens. The entire floor space of 160 feet was available to the birds, as the walk was elevated above the floor so as not to interfere with its use. Equal yard space was attached to each room."

There were four groups of fowls, two groups being of light Brahmas and two Plymouth Rocks, and in each group, there were four pens. The following is the result:

Group 1 with 15 in each pen laid 65.1 eggs per bird.

Group 2 with 20 in each pen laid 60.4 eggs per bird.

Group 3 with 35 in each pen laid 51.4 eggs per bird.

Group 4 with 30 in each pen laid 40.1 eggs per bird.

Group 1 had 10.6 square feet of floor space per bird. Group 2 had 8 square feet of floor space. Group 3 had 6.4 feet, and group 4 had 5.3 square feet per bird. The greater the floor space per fowl, it is seen, the greater the egg yield.

Of course the financial result is another matter. The following was the income from each pen less cost of food:

Group 1, 15 hens per pen, $12.02 per pen.

Group 2, 20 hens per pen, $14.16 per pen.

Group 3, 25 hens per pen, $13.14 per pen.

Group 4, 30 hens per pen, $6.06 per pen.

It is seen that while the income per bird was greatest for group 1, with 10.4 square feet of floor space, the income per pen was greatest for group 2, where there were 20 birds in the pen, or eight square feet of floor space per bird. In other words, the results show that you will get with floor space of 160 equare feet more from 20 birds than from any other number. So that if you have a pen of that size and you have more than 20 fowls, it will pay you to kill off and throw away the excess above that number rather than crowd them all into that space.

The Question of Breeds.

The question which breed is the most profitable, is one that has never been satisfactorily answered. In our experiments at the Station we nave been making, incidentally, some comparisons with different breeds. We have tried the Brown Leghorns, the Light Brahmas, the Barred Plymouth Rocks, the White Wyandottes, the Black Leghorns and we now have the Buff Rocks. It is a difficult matter to decide by experimentation the merits of the different breeds, for several reasons. The first difficulty is that different breeds require different treatment and feeding. To give a pen of Light Brahmas the same feed and treatment as a pen of Leghorns, would not give results that would offer a fair comparison of their egg-producing qualities. Were it known definitely how to feed and manage each of these breeds to best advantage the problem would be one very much easier of solution. Another difficulty in breed experiments is the fact that different strains of the same breed vary in egg-laying capacity. That one strain of a certain breed does better than a certain strain of another breed, must not be taken, as it frequently is, as deciding the relative merits of the breeds.

In our experiments in egg production, without taking into consideration the market value of the hen before and after the experiments, which ran a full year, with the strains of fowls we had and with the feeding and management given, the Leghorns show a much greater per cent of profit on food than the Brahmas, Barred Plymouth Rocks, Wyandottes and a Brahma-Leghorn cross. That has been our experience, but it is not our conclusion as to the value of the breeds represented. During the three years for which experiments have been completed Leghorns have averaged 188 per cent profit on food consumed. That is an average of a number of fowls, not an individual record. The best we

have been able to do with any of the other pure-breds was 75 per cent. In egg records the average of a pen of Leghorns has exceeded the best record made by any pen of any other breed.

At Logan, Utah, prices of food we have found that Leghorns will consume an average of about 60 cents worth of food during the year. The Brahmas will consume about 40 per cent more, the Plymouth Rocks about 30 per cent more and the Wyandottes about 25 per cent more than the Leghorns.

The Question of Feeding.

Probably the most difficult problem of poultry keeping is that of feeding. The question how to feed and what to feed for best results in egg production, is a very highly important one and is now engaging the attention of various experiment stations in this and other countries.

In the first place, the hen requires a variety of food if for no other reason than to improve her appetite so that she may consume food enough to produce eggs in abundance. A hen should no more be fed on wheat alone than a man on bread alone. A short study of the composition of wheat and eggs will explain why a profitable egg yield cannot be expected from wheat alone. Supposing you feed a hen which weighs 3.5 pounds 3.25 ounces of wheat a day. Of course, a hen of that weight would not long consume that weight of wheat alone. Supposing, further, that the hen uses 2.75 ounces of that for the maintenance of the body; that leaves half an ounce to be converted into eggs, assuming that all the food is digested, which, of course, is not the case. In half an ounce of wheat, there is about .06 of an ounce of protein. So that, assuming the the hen consumes and digests 3.25 ounces of wheat per day, and that she uses 2.75 ounces of that for maintenance of the body, there is then available each day just one-quarter enough protein for one egg. But the egg has other constituents, so has wheat. The half-ounce of wheat contains about one and one-half times as much carbohydrates and fat as one egg contains.

So that the hen fed on wheat alone has a surplus of one material and a deficiency of another. In other words, she has enough carbohydrates and fat to make an egg and a half a day, but has only protein enough to make one egg in six days. So, you see, you place the hen in an awkward position by feeding her wheat alone. Wheat does not contain the egg-making materials in

proper proportion. Corn is even worse than wheat in this respect.

The question naturally arises, is there any one poultry food that contains the egg-making material in the right proportions. That question might be answered in the affirmative. It might be said that such a food can be purchased in Cache Valley by load for four dollars per ton. I refer to lucern. Lucern has egg-making materials in the right proportions. It has a nutritive ratio of 1 to 4 or 5 which authorities recommend as a good ration for egg production. But alfalfa is too bulky. A hen could not eat by any process of cramming enough lucern to produce eggs profitably. This shows the necessity of feeding the hen in such a way that she will have not only the materials in right proportion, but in such shape that she can secure the necessary amount of materials.

What constitutes a good variety? If not too expensive, let wheat constitute the principal item of the ration. It may constitute about one-half of the total weight of the food. Next, there should be grit to grind that grain. Then as a third item, they need green food, such as cabbages, lucern, etc. With those three things the hens will lay eggs. But the question with practical poultrymen is not how to get eggs; it is how to get them in sufficient abundance. It has come now to be the belief among successful poultrymen that the hen requires some sort of animal food for best results, and cut bones or "butcher's scraps" on which there is a considerable amount of meat are largely fed to supply this item. So that we now have four essentials for an egg ration: Grain, (concentrated food), grit, green or bulky food and animal food. If the poultryman having these four foods and feeding them in the right proportions and in the right way, there is something wrong in some other direction if a flock of a thousand hens does not pay its owner a profit on the amount of food consumed of one thousand dollars a year.

An Egg Ration.

In our experiments at the Station we fed a pen of Leghorn pullets the following amounts per bird during the year: Mash, 10 lbs.; wheat, 27 lbs.; cut bones, 10½ lbs.; corn, 6½ lbs.; oats, 14 lbs.; barley, 1 lb.; lucern, 4½ lbs.; cabbages, 4 lbs.; a total of 77½ pounds. The mash was composed of two parts bran and shorts, one part each of ground oats and corn, mixed with

water and seasoned with a little pepper and salt. The cut bones were a mixture of bones and meat.

Method of Feeding.

The method of feeding was as follows: The mash was fed the first thing in the morning. Toward the middle of the forenoon a light fed of grain was given, wheat, corn and oats, alternating. About three or four o'clock in the afternoon wheat was fed, all the hens could eat up before roosting time. All grain was fed in a litter of straw six inches deep, inducing exercise. The cut bones were fed three times a week. During the winter months a cabbage head was kept hanging in the pen all the time. In summer the green food was green lucern or clover, principally lucern. This was cut and thrown into the pens.

Results.

On that ration and method of feeding a pen of Leghorns laid an average of 182 eggs per fowl during the year. The food consumed cost, at Logan, Utah, prices, and paying market prices for everything, consumed 62 cents per fowl. At Logan store prices for eggs, the 182 eggs were worth $1.77, or a profit of 203 per cent on food cost.

Confirmatory Results.

During the second year—the year beginning November 1st in each case—another pen of Leghorn pullets consumed the following amoutns of food: Mash, 8.2 lbs.; wheat, 32.5 lbs.; oats, 20.2 lbs.; bones, 8.8 lbs.; corn, ½ lb. The green food consisted of lucern and lucern leaves thrown into the pen. This food cost 60½ cents. The egg yield was 165 per fowl, worth $1.78, a profit of 198 per cent on the food.

The results of the third year have not been published yet, but they are practically the same as the previous years.

POULTRY ON THE FARM.

By R. N. Sutherlin, White Sulphur Springs, Montana.

The farm is the natural home of the domestic fowl. Wild fowls even love country precincts where the husbandman holds forth. The conditions which exists in the country home, on the farm are especially adapted to the well being of poultry. The skill of man provides other conditions than these under which birds are propagated successfully but the most cheaply supplied appliances, feed, range, etc., necessary for the good health and a life of useful activity on the part of fowls is found in our country homes. We have been a persistent advocate of poultry raising and egg production for twenty-eight years. There isn't anything else on the farm that will yield the profit that hens do. They in point of investment eclipse the swine herd, the horse herd, the cattle herd, or a flock of sheep. Briefly told, the hen will yield one dollar per head annually above the cost of keeping. A hen should not encumber the premises of a farmer unless she will lay twelve dozen eggs in a year and these will average twenty cents per dozen here or a gross income of $2.50 and one dollar and forty cents will purchase the feed and it may be produced on the small farm for less money. There are few flocks of ewes that will do so well. The poultry flocks of Montana, contrary to the general belief, are the best paying property in the state and yet many of them have only ordinary care and quarters. To get the best results it is necessary to give fowls the best of attention but if only the care is exercised that is required to make a success of hogs, horses, cattle or sheep, poultry will yield far in advance of any of these branches of husbandry and the income from a flock of hens is almost continuous the year around. Eggs and friers and broilers are commodities that will always command cash and the farmer who will keep a colony or two of hens will find that he will never be without ready money.

The first requisite to success in poultry keeping on the farm is

a warm house, a house in which water will not freeze in cold weather. The professional poultry raiser may find it profitable to build houses on the apartment plan and warm them with artificial heat, but the one plan that recommends itself to the farmer is the colony plan and houses sufficiently warm so that the inside never experiences the temperature of freezing. There are dozens of plans for building houses for the countrystead that are good. Gravelly ground is the best. Log houses made of large logs and covered with earth are cheap, but the cheapest, warmest house is made in the ground but this can only be done in dry soil. An ordinary board house may be rendered warm by sodding it around the sides and over the roof, and exceptionally good, cheap houses are made by building two houses one within the other, leaving a 24-inch space and filling this with dry manure. A more expensive house is built by making each of three walls tight and leaving the space between, a dead air space. The difficulty in securing a dead air space in this house is the only drawback to it. We would recommend storm, or double windows and doors on all houses and so arranged as to let in the sunshine. Sunshine is especially essential during the winter months when you desire to cajole your hen into the belief that it is summer time and that they should lay. When your house is warm and light half of the battle is accomplished. You may have it in two apartments or one, as you see fit, two is preferred. When you have two rooms to the house the back room should be lighted from the front room so that it will always be a little dark. Hens like a dark room for nesting. And they are equally fond of sunshine when scratching and hunting for feed.

During the months when it is necessary to keep the fowls indoors it is necessary to cover the floor with chaff or straw. The whole grain feed scattered in on this gives them work for the day. If only one room is used for a flock the nest boxes may be put under the drop boards and entered from the back so that the laying hen will be in quiet and seclusion. Next thing to warmth in the chicken industry is cleanliness. The good housewife can not rest when bed bugs infest the home and the hen is equally restless if vermin infest the hen house. The roosts must be coal oiled frequently and the house sprayed with kerosene emulsion. If white washing is necessary put a little corrosive sublicate in the whitewash. Fumigation is also resorted to and where the houses are fine they may be painted inside and out but for

ordinary houses kerosene emulsion spray is sufficient. In the matter of feed, some grain is always necessary but for a warm mess in the morning a cheap diet is made by cooking vegetables.

Green stuff is very necessary in winter. Hens will eat a large amount of hay if given access to the hay ricks but it is best to run alfalfa through a cutter for them or feed them on the shattered leaves of alfalfa. Sugar beets, turnips, rutabagas, and cabbage also make a good green food. Fresh ground bone is also very essential when confined, fresh water is absolutely necessary. Most farmers keep their hens until they are too old. Under no circumstances should the hen be kept more than three winters, except she is a good mother and you keep her for a purpose. The best winter layers are pullets hatched in February. The pullets hatched in May probably give the best results the second winter. We are not in favor of separating all the roosters from the flock in winter. Fifty fowls in a house is sufficient and three dozen even do better. A building twelve by thirty feet will make a good double room house and will accommodate fifty hens. We will not attempt to designate what varieties are best. All are good but some are better than others. The Mediterraneans are world beaters for eggs, and our American birds are famous for general purpose fowls. The Asiatics lay large eggs, are good winter layers and are nearly as large as turkeys when dressed. For farm fowls the Indian game bird is rather the nicest flavored for table use, but the Game Bantam beats them all. But the Bantam is essentially a city fowl and is not calculated for the country home. It is, next to the wild pheasant, the finest morsel ever cooked, but it is not popular owing to size as a barnyard fowl, but is nice for the city where the space is small and people have delicate appetites. We can scarcely compass so large a subject at one time without becoming tiresome. But we will just take the time to say that hundreds of people nestling on small premises hid away in these Rocky Mountains are making a good living off of three or four cows, the skim milk being fed to the fowls, and two or three colonies of hens. In every season of the year eggs should be marketed weekly and date marked on the case. One of Montana's best poultry raisers assures us there is more and easier money in 15 cent eggs in March, April and May than in the 30 or 40 cent eggs from Oct. 1st to January 1st, but he says there is no reason for not having both. If there is any one in the Rocky Mountain Northwest who can not make poultry

on the farm profitable let him write the Rocky Mountan Hus. bandman, state the condition and we guarantee to point out a remedy. We guarantee to provde a formula for making hens lay in winter, in fact, for making them produce 150 eggs a year and we believe the 200 eggs a year hen is a possibility within the near future. It has been accomplished in New England and what is possible with poultry there is possible here. It is as natural for the hen to lay as it is for water to run down hill. The conditions that insure this are simply these, young hens of any of the leading varieties, a warm sunny, well ventilated, but not drafty hen house, a variety of feed, freedom from vermin, clean water and plenty of exercise. If things fail then write to us and state your case.

This article has been confined exclusively to chickens, but they are not the only fowls that are profitable on the farm, but to consider turkeys, ducks, geese, etc., would require too much space. Then chickens head the fowl kingdom and in fact lead as an auxiliary branch of husbandry.

SECRETS OF PROFITABLE DAIRY HUSBANDRY.

B. F. B. Linfield, Agriculturist Experiment Station.

This is the first time that I have had the opportunity of talking to an audience in Stevensville upon some phase of the subject that I will bring to your attention this morning. Perhaps some of you may think that to talk upon this line of dairying in a fruit district such as this, might not be of as great advantage to you as time spent in discussing some other phase of farm work; and yet, it appears to me, that this work of dairying—the keeping of cows, the production of milk, the utilizing of the fodders upon the farm in the production of dairy products is something that will fit in well, and with advantage, into your work as fruit growers. Your fruit industry occupies you during the summer, and you want something to occupy you during the winter time. Some people may think perhaps that this is a disadvantage; but as the matter appears to me it is an advantage. I have been talking to a great many people over this State and they have complained

that for a great portion of the year they have nothing to do, nothing by which they can gain anything or add anything to their incomes. This dairy business, properly conducted, rightly understood, will furnish you this profitable occupation at all seasons of the year. From a farmer's standpoint that is a decided advantage. I do not know of any business that will support a man who works only six months in the year. We have got to have some profitable employment at all seasons of the year to be successful.

The secrets of profitable dairy husbandry—I do not know that I am going to present a new topic; rather an old topic, perhaps under a new name, and while I may not refer to all of the points which will bring you success in this work as dairymen, I want to refer to a few of the more essential ones.

The Man.

In the first place, as has been said this morning already, we must have the man,—a big man, an intelligent man, a man who makes a study of the business. There is no business that any man is engaged in that ever gets bigger than the man. Whatever succes you may attain in any line of work will in a large measure depend upon the intelligence and skill that you put into that work. To me there is in this idea a very important thought that none of us should forget. The farm, the stock, should be an index of the man. Into those animals he has put this intelligence, and in a large measure they reflect what he is. Because unless he puts into these animals the intelligence that the business calls for, they are not going to attain to that high standard of quality which it is possible to attain. I like the idea of the farmer being a man of professional skill. We should not forget that a first great essential to success is to have a high opinion of our calling. Judging from the large number of young men growing up upon our farms who are not going to follow the occupation that their fathers have followed so successfully in laying the foundation that has been laid in this country, there is something wrong; they have a wrong idea of things. I want to say that upon the farm I believe there is just as great a scope for all the powers of the man as in any other occupation in which he may engage.

The Farm.

There is another very important point, the farm. It is a very

essential point, because a good dairyman is no less a good farmer and the best farmer is the best dairyman. The man who raises the largest crops is the man who is going to feed the largest number of cows, the man who is going to get the largest amount of money out of every acre of land that he has. I have figures that will demonstrate to you what may be done with an acre of land properly cared for under dairy farm methods.

Good Cows.

In the next place, you want a herd of good cows. It seems to me that very few people have a definite idea of what a good cow is. There are very many people who have cows that instead of returning to them a profit are just being kept upon the farm. I don't know why, unless it is that their owners fall in love with them and cannot part with their company. In getting good cows there are two points to note: you have either got to buy them or you have got to raise them. In selecting the cows there are a few points to be noticed, and I find that it pays well to study exactly what a good cow is. I am not going into details upon this point, but will give a general outline from the standpoint of appearance. If we look at this animal from the side view we will find that she has a wedge-shaped form. She is slim in the neck, fine in the head, long from the eye to the muzzle—a cow-like appearance in the head—a well-sprung rib, a large barrel or middle piece, a well developed hind-quarter, and a well developed udder, deep in abdomen. The development of these parts is what gives her the wedge-shaped form. There is a reason for this. I find that the cow must be well developed in that region where she stores her feed. I find that the large feeding cow, the cow that has the capacity to eat a large quantity of food, is the cow that produces the largest quanity of milk and butter. The cow that eats the most (if she is a dairy cow) is the cow that produces butter at the least cost per pound, in other words, she is the most economical producer. I want a cow with a large and well developed middle piece. Another point to note in the cow is to look at her from above. You will find if she is a good cow that the shoulder comes to almost a point, but towards the hind quarters she widens out. Yet another point, if you stand at the front of her and looking at the shoulder down you will find that here she also widens out giving chest capacity.

The Udder.

These are the main points in the build of a good cow. Then examine the udder. She should have a well developed udder, a large capacious udder, not a pendulous udder. But do not be deceived by a fleshy udder. I find a good test of a large milker are the large milk veins. If you place your hand beneath the abdomen of the good cow you will find a large vein. It is the vein that carries the blood from the udder back again to the heart, (because you know milk is produced from the blood). A large amount of blood going through the udder is indicated by this large vein passing along the abdomen of the cow. This vein stands out quite prominently on a new milch cow.

It Will Pay to Study the Cow.

It will pay you to study this question of the cow. A few years ago at the Utah College we purchased a herd of common cows which averaged 250 poundes of butter fat in one year. We have accumulated no dairy experience in Montana as yet and so I must revert to my Utah experience. One of the cows produced in one year 337 pounds of butter fat or 392 pounds of butter. It is possible for you by studying this question of the cow to select such cows yourself. They are hard to get; there are so few of them in this country; but yet it is a possibility.

Producing the Cow.

The next point is the question of producing or raising the cow. I believe the only successful way finally for the dairyman to get a good herd of cows, is to raise them. In the first place, in order to get the foundation stock we have to weed out the poor cows, keep the best and raise calves from the best. See that your calves are well born. I remember some years ago one of the professors at the college speaking on the life of Oliver Wendell Holmes. He traced his ancestors back to the early history of this country, and followed up the record to recent times. He found that his ancestors were men of prominence in the locality where they lived. men of sterling worth and character. With such an ancestry how could Oliver Wendell Holmes be otherwise than the great man he was? A great many of us forget that this principle applies to our stock; see that they are well born. I want to see that the ancestry of the animal, as far back as it can be traced. shows a capacity of producing the right quality and quantity of butter—of doing largely the work we desire to have done in our herd .

I have met some people who have said that the people of their locality had introduced a Hereford bull into their herd in order to improve the milking qualities of their stock. It would be just about as wise to buy a bull dog to hunt birds. The Herefords as a breed are not milk producers. Have nothing to do with them on the farm of a dairy specialist. In the systematic improvement of your dairy herd the sire must have the ancestry which says that his progeny will be good dairy stock. But don't understand me as condemning the Herefords; I am speaking of them only as dairy cattle. I repeat, see that the dairy bull is well born, inheriting from his ancestry the qualities you desire to perpetuate in your herd.

Some years ago I bought a few cows for the Utah College. Amongst them we had some capable of producing 42 pounds of butter fat in a month. That means about 48 to 50 pounds of butter, and yet after seven or eight months milking they went dry. It is a question of bad training. I do not care how good othe heifer is from our common stock, if you allow her to go dry three, or four, or five months before she comes in fresh, in two years you will spoil the cow. We are very particular to milk the heifer to within two months of calving even if she gives but a small amount of milk.

Feeding Skim Milk.

I believe in raising the heifer calves on skim milk. I do not know of any feed that is better. We had at the Utah College a young Shorthorn which weighed 92 pounds when dropped. At eight months of age he weighed 622 pounds. After he was six weeks of age he never had a drop of whole milk. He was first given skim milk when ten days old. He gained 2.2 pounds per day from the time he was dropped. Is not that a good growth for an animal. But he was given something else besides skim milk. It was supplemented by a little grain. But grain worth three-quarter cents a pound is very much cheaper than butter fat worth 20 cents per pound. The best price we have got for butter fat fed to a calf has been 10 cents per pound when we sold the calf at 4 cents per pound live weight. This was but 40 cents per hundred for 4 per cent milk. We have skimmed the milk, sold the fat for 68 cents and fed the skim milk and received 20 cents per hundred pounds for it, thus receiving 88 cents for 100 pounds, of milk made into butter and calf. Did it pay to make the butter?

Developing the Milker.

There is a point right here about developing those animals. You should bring the heifers in when about two years old, but do not bring them in the second time until they are three and one-half years, or allow a year and a half between the first and second calf. This permits them to grow and get their size. We milk those heifers to within two minths of their coming in fresh again. Do not, under any circumstances, dry the heifer off because she may not be giving enough milk to pay her way. It will pay you to watch this point.

Cow Records.

In figuring out the records of the cows at the Utah Station, I found that one cow had produced 203 pounds of butter in the year, another 333. The best cow returned at 17 cents per pound for butter fat, $56.60, without reckoning the skim milk or the calf. Now as to the cost of feeding that cow; reckoning four dollars a ton for alfalfa, 75 cents a hundred for all grain it cost in one year to feed her $22.50. So that we got from that cow $34.00 profit on her food. At Montana prices the food cost would be more but so would be the value of the product.

Supposing we had sold our fodder, the hay and the grain, (and we produced large quantities of it on the farm) we would have got at the highest market prices just $22.50 for the food consumed. Instead of selling it off the farm we sold it to the cow. But you say, there is a certain amount of labor to be considered. That is true, but is not profitable labor, something that we want. Without taking the labor into account we got $2.50 for every dollar invested in feed for the cow. There is no better investment a man can make of his fodder on the farm than to so use it. The very poorest cow of the herd returned nearly two dollars for every dollar invested in the feed given her.

Some of the heifers returned to us a profit over and above the cost of feeding them, at the prices given, of from $18 to $20, even two year old heifers, bred in the way that I have called your attention to.

Profitable Feeding.

Then as to the question of feeding, we should grow the kind of crops that will give the largest quantity per acre, and combine those fodders in such a way as to get a ration that will be satisfactory. Alfalfa and clover hay cured with the leaves upon it is

our best and most economic fodder. Then the next point,—if we desire to get the best results, we must feed a little grain. I have found that it paid to feed grain, say from 4 to 7 pounds in the winter time. It may not be from the immediate increase that you get the profit by feeding this grain, but we have developed our cows so that the next year they would do better than they did the year before. Here is where we get the returns from the extra feeding.

Summer Feeding.

We then experimented in the summer feeding of those cows at the Utah College and I will give you the results. It is possible for you to do even better. The land is poorer than yours. It is a leachy soil, and yet on one acre of land we pastured two cows for about four months. Those cows produced on that one acre of pasture—one of the cows being a new milch cow, the other was milked from the September before—234 pounds of butter. If sold at 20 cents a pound the returns would be $46.80. Is there any other crop you can grow—not speaking of fruit—that will give you as large returns, considering the labor involved.

I thought in the Utah experience I had a good story, but as I said you can do better. When I came to Bozeman last fall and looked over the records I found that on one acre Prof. Shaw, my predecessor, had pastured four steers for three and one-half months and obtained 900 pounds gain in live weight. On the Utah acre pasture, Prof. Sanborn obtained 425 pounds of increase in live weight on steers, this was about two pounds of beef for one of butter. Now on the same basis, the Montana acre that produced 900 pounds of beef should produce over 400 pounds of butter worth at 20 cents per pound $80.00. But you must milk the cow to get it.

Manufacturing and Marketing the Product.

Another point to consider is the question of manufacturing and marketing the product from these dairy cows. There are two ways of doing it—by the home dairy or the factory. It is quite possible to produce in the home dairy as fine an article as can be produced at the factory. In the majority of instances, however, the home dairy has not the necessary appliances that will enable the people of the house—generally the ladies of the house—to do this work in the best way and with the least amount of trouble. When talking on the subject of butter making on the farm some years ago a lady said to me: "It is all very well for you to come

around here and tell us how to make butter, but we haven't got these appliances you refer to. Out on the farm the men will have their self-binder, the sulky plow, rake, mower, etc., but in the house we have to put up with the apparatus our grandmothers had. What is wanted around here is a new lot of men." It strikes me perhaps there is some force in the argument. Think over that proposition. I believe it is possible to produce as good an article of butter on the farm as is produced in any factory in the state. I believe, moreover, that if you had the best appliances to handle it you would be able to save one-half if not three-fourths of the labor bestowed upon that work. I believe it should be our duty as heads of the household, if we require the butter to be made upon the farm, to see that the improved appliances are provided.

But those of you who are convenient to be a factory patronize it. I believe if you will combine on a proposition of that kind it is possible to do well by the factory. I call to mind a little experience in buying milk for the dairy in Utah. One man said that he had four cows, and last year those cows returned to him an average—they are not extra good cows—of forty dollars each. Another man was paid a check for $21. I asked him how many cows he had. He said he had four. That was little over five dollars a month for each cow. He fed nothing but alfalfa to those cows, and alfalfa in the stack was selling at $3 per ton. Another man who had something like twenty cows received $28 for the month. He said, "There is not very much money in handling cows," and he was right as far as he was concerned. But was it the cow's fault. If this is your experience do not forget that the cows you have are what you made them. If they are not paying you, it is your fault, not the cows'. Do not forget it; don't blame the cows. The factory system I believe is the best method if you are situated so you can use it. It is one of the keys to success.

Finally get good cows, feed intelligently; get the best appliances for making the best quality of butter, both in the dairy and in the factory, and I think you will find, as I believe it to be, that it is one of the most profitable lines of farm work that any one can engage in.

DISCUSSION RAVALLI COUNTY.

Question. Will Prof. Linfield verify the statement that one cent per pound can be realized by feeding grain with forage crops.

F. B. Linfield. I can only answer by illustration. A good cow will produce 250 pounds of butter in a year, worth at 20 cents per pound, $50.00. The calf and the skim milk is worth something. This cow will not eat more three tons of clover or alfalfa hay worth at $5 per ton, $15.00, 1,000 lbs. of grain at 1 cent per pound, $10.00 and five months pasture at $1.00 per month, $5.00, a total of $30.00 for the year. Will $50.00 pay the bill?

We have sold hogs the past year at 5 cents to 7½ cents per pound, live weight. A young and growing hog up to the 175 to 200 pounds, live weight, will give a pound of increase in live weight for from 4 to 4½ pounds of grain, if they have the run of a pasture in the summer or are supplied with a little clover hay as roughage or with roots in the winter. This, it seems to me figures out alright. There are outside figures for intelligent feeding. I have made the gains at less food cost.

The return from feeding steers or sheep depend very much upon the difference between the buying and selling price. The profits comes from the increase in value of the original weight of the animal due to the fattening.

During the past winter we made over $2.00 per head on each sheep we fed, after paying for the feed at market prices. We paid $507.89 for the sheep, we fed them $282.12 worth of feed and received net $1,350.00 for the carload. What did we get for our hay and grain?

Question. What kind of hog do you prefer?

F. B. Linfield. Selecting a breed of livestock for another person is a good deal like choosing a wife for him. The chances are ten to one you won't please him. All breeds have their peculiarities, their strong and weak points. Study those peculirities. Again there is a great difference in different families of the same breed. Select that which best strikes your fancy, getting at the same time a strong, vigorous hog.

Question. How about Jersey Reds?

F. B. Linfield. The Jersey Reds or Duroc-Jerseys are good swine, strong, vigorous and generally good breeders. As far as my observations go, they have not been bred as fine as some other

types. If the "Reds" take your fancy they are a safe thing to tie to.

DISCUSSION AT GREAT FALLS.

Remark. Are the long dry autumns we have here and the scarcity of green feed against dairying?

F. B. Linfield. In Utah we have about the same autumns, and as to dry weather it makes it rather favorable to the production of dairy products. Green feed is not necessary where you have as good cured feed as you have here. The climatic conditions are almost ideal.

Remark. How about raising chickens with an incubator? Can it be done successfully?

F. B. Linfield. Yes, it can. You almost have to use an incubator for early chickens. It cannot beat the old hen in producing a large proportion of chickens from eggs. If properly handled an incubator is successful as a chicken hatcher.

Remark. How is the Ayreshire cow for milk?

F. B. Linfield. Good. They are probably one of the hardiest of the dairy breeds, but they have to be handled carefully. They will stand running out better than almost any other breed. The Jersey requires good care and handling and generally requires a little more grain, but makes good use of it.

Remark. How do they compare with the Holstein?

F. B. Linfield. The Holsteins give more milk, but it is not so rich as the others.

Paris Gibson. Does not the excess of milk make up for the deficiency of value in Holstein.

F. B. Linfield. Yes. Although the milk is poorer in fat the total product is a thing to be considered. I would rather have a cow that gives 45 lbs. of milk per day testing 3 per cent than one that gives 15 lbs, per day with 5 per cent fat.

Paris Gibson. The Holstein are my favorites. I think they are the finest cows in the world. I like Holstein for Montana particularly because they are so exceedingly healthy. In my experience I have had no diseased animals. They are gentle and large. I cannot quite concur with you in your recommendation that if a man wants to make beef he should not have Holsteins. There is prejudice against the Holstein on the range. I think it did not originate there. It probably originated in Chicago with such people as Armour & Co. I do not believe the Holstein is equal to the Hereford or Short-horn cattle as a beef animla.

The experience of some of our best breeders is that they take on fat quicker than an beef breeds they have tried. I believe, and it is based upon my own experience and observation, that there is not a better dairy country on the face of the earth than right here in Montana and yet we are shipping 50 per cent of our butter consumed in this state from outside. I further believe that alfalfa is the greatest feed I have ever seen for dairy cattle.

BUTTER MAKING ON THE FARM.

By F. B. Linfield, Agriculturist Experiment Station.

Butter-making is a very broad subject to attempt to cover in one talk and I shall therefore touch only on the more important points.

Pure, clean-flavored milk is an absolute essential. This calls for carefulness and cleanliness in milking the cow, in the care of the milk and the utensils used in handling it. Without dwelling upon this part of the subject, I will to-night deal only with the manufacturing process and tell how we do the work. We do not claim that the method described is the only good method, but we have found from practical experience that it gives good results, and can recommend it to any person who may be in difficulty

First Point.

The first point in butter making is creaming the milk. There are three methods commonly practiced in this country: first, the shallow pans; second, the deep pails or creamers; and third the centrifugal machine or separator. The shallow pans are an old method of setting milk which has been followed for several hundred years. To get the best results, that is, to take as much as possible of the fat out of the milk, set the milk as soon as possible after milking; set in a cool place about 60 degrees F., and let the milk stand for from 24 to 36 hours. It is generally recommended to skim just as the milk is getting sour and before it gets thick. In skimming, the method I have found most convenient is to loosen the cream from the sides of the pan, rest the pan on the cream can, and the cream flows over the sides of the pan into

the can; the milk that goes over will do no harm. The great danger in using shallow pans is contamination from the air. The pan should be set in a pure, dry atmosphere, and the milk-house should not be used as a storehouse for vegetables either cooked or uncooked. A few yeas ago, in eight months of the year, while on a lecturing tour, I churned over 150 samples o cream from as many different farms, and the flavors were nearly as diversified. The flavors of onions, cabbage, and other vegetables were sometimes very pronounced, and in a few instances when the cream was from a damp mouldy cellar, the mould was strong enough to catch a person's breath. Our experiments indicate that the cooler the place in which the milk pans are set, providing the milk does not freeze, the better the results in thoroughness of creaming. It is therefore a disadvantage rather than otherwise to place the milk in the pantry, as is frequently done, provided the milk be kept in a place not cold enough to freeze it. The skimming will be more thorough and the flavor of the butter much improved.

The deep pails or creamers, (of which there are many modifications) generally, if properly handled, give better results than the shallow pans for the whole year. The milk should be set as soon as possible after milking in ice-cold water, the colder the water the better the results. I have found that by using running water at 52 degrees to 56 degrees F. one-fourth to one-third the butter was lost in the skim milk. To illustrate from a herd of cows giving 200 pounds of milk a day: By using water 52 degrees to 56 degreesF. we have 160 pounds of skim milk testing 1.2 per cent fat, a loss of 1.92 pounds fat, equal to 2.11 pounds of butter a day. By using ice the loss is reduced to .3 per cent fat, or .48 pounds of butter fat, which is equal to one-half pound of butter, or one and one-half pounds less than with the warmer water. Allowing butter to be worth 20 cents a pound, we have a gain of 30 cents a day, of $9.00 per month. I would, therefore, advise the use of ice if these creamers are used, cool the water below 40 degrees F. and skim every 24 hours. In using those pails that skim from the surface I have found a small cone-shaped dipper very satisfactory if handled carefully. In using those pails that are arranged to draw the milk from the bottom, I would in every case leave three-fourths of an inch to one inch of skim milk with the cream, if the cream is to be made into butter, as this milk is generally very rich in fat.

The Separator.

The hand separator which is now being used quite extensively, is better than either of the above methods, as when properly handled it takes practically all of the cream out of the milk. It is easy of manipulation, and with good care will last for years. It may be run by hand and do good work, as I can vouch for by taking my turn at the crank. However, like turning a grindstone, it gets very monotonous, and when twenty or more cows are kept a small tread power will be found handy. The separators are expensive, yet I am convinced that a hand machine which will separate 450 pounds of milk an hour would pay for itself in two years or less with a herd of fifteen to twenty cows, due to the extra amount of butter obtained as compared to any setting method. If compared to a creamer where no ice is used, it would pay for itself in one year. Our experience with ten or eleven cows was a saving of ten to fifteen cents per day over ice water.

Care of the Cream.

The care of the cream is of very great importance in securing a fine article of butter. A tin can with a tight cover is much butter than a crock for holding cream. Every time fresh cream is added to the cream in the can it should be thoroughly stirred.

Keep the cream cold till enough is gathered for a churning. With separator cream, it should be cooled immediately after separating. The cream for one churning should go all together in one vessel from fifteen to twenty hours before it is churned: fresh cream added to it later is likely to be lost in the buttermilk.

Ripening the Cream.

Ripening the cream is somewhat difficult to advise upon and difficult to perform. The object sought is the development of flavor in the butter and has to be modified somewhat to suit the market. Ripened cream generally has a slight acid taste, is some what thick, and has a velvety or glossy appearance. To ripen the cream, warm it to 60 degrees or 68 degrees F. (this depends upon the kind and age of the cream and also the season of the year, no absolute rule can be given) about twenty hours before it is to be churned, and hold at that temperature. I find that the best means of warming the cream is to place the cream can in a tub of warm (not hot) water and stir occasionally. In the fall and winter, particularly for deep pail or separator cream, warming alone may not ripen the cream quickly enough, and so

I would advise the use of a starter. In a small dairy this starter may be prepared as follows: Twenty-four hours before you start to ripen the cream fill a bottle, (Mason fruit jar will do) which has been thoroughly cleaned and scalded, with clean flavored skim milk. The size of the bottle will depend upon the amount of cream to be ripened. Warm this milk to about 70 degrees cover tightly and keep in a warm place. This will sour and thicken, and should be broken up fine and added to the warm cream as a ripening starter. We ripen the cream because the market will pay more for the butter made from it.

Churning Temperature.

The churning temperature is something which very many people know but little about. I have heard of people churning all the way from five minutes to twenty-four hours or longer. Now between these two points, namely temperature and the time of churning, there is a very intimate relation. There is no definite churning temperature ,the ordinary thermometer to the contrary notwithstanding. My rule is to churn at such a temperature as will bring the butter in a reasonable time, twenty to thirty minutes for a hand churn; forty to sixty minutes for a power churn. When butter churns in five to ten minutes we get a soft butter; but for a hand churn one hour is too much work. I have churned cream at temperatures ranging from 50 degrees to 75 degrees F. As a general rule from 55 degrees to 68 degrees F. will be the range. If the butter churns in a short time and is soft next time cool the cream; or if it takes a long time to get the butter, warm the cream a few degrees the next time you churn, other things being equal. There are many modifying conditions. as the size of the churn, and amount of cream in it, the age, kind and acidity of the cream, the manner in which the cream has been handled, and the temperature of the churning room. Cream has to be churned warmer in winter than in summer, and warmer after the cows have been milked for some months than when they are fresh, while cream from a separator requires a lower temperature than the cream from the setting method. These are all important points, but the full explanation is beyond the limit of our time. I would, however, very strongly advise every butter maker to buy and use a thermometer; you may get along without it, but for an intelligent understanding of the work it is indispensable. A carpenter or mechanic without his rules, squares etc., or a surveyor without his compass and instruments, is not

more helpless. They may get their work right, but are much more likely to get it wrong, and will never be more than "jobbers." Their work or products nearly always sell at the bottom of the market; and so with the butter-maker who works by "rule of thumb."

Churns and Churning.

Churns in number are legion, but the really useful may be counted on the fingers. Any style of revolving barrel or box, or any swing or rocker churn without any dashes or fixtures on the inside are preferable. They are easy to operate and easy to clean. The old style dash churn does good work, if carefully handled, but means hard work compared to the amount of butter made; nor is it as easy to get the butter out of them in the best condition. The preparation of the churn for the cream has much to do with keeping the churn clean. First, put in a pail or more of boiling (not merely warm) water; and then cool the churn with cold water before putting in the cream. The cream should always be brought to the proper temperature before being put in the churn. Always strain it through a dipper with perforated tin bottom, thus removing any hardened specks of cream or sour milk. (In the churning experience referred to in speaking of shallow pans setting, we occasionally strained out many other things.) If coloring is used it should be put into the cream at this stage. The amount depends upon the season of the year and the requirements of the market; never use too much; better a little under than over color. Cows do not give us much color in their butter after they have been milking for some months or when on dry feed, and the aim should be to keep the butter uniform in color throughout the year.

In using the revolving or swing churns never fill them more than one-third full of cream. The speed should be such as to give a distinct concussion of the cream. Either too fast or too slow retards the churning. In an air-tight churn the gas which nearly always generates should be allowed to escape.

When the butter breaks, watch it carefully, and after it has gathered to about one-half the size of wheat grains the buttermilk should be drawn off, straining it through the dipper that the cream was strained through in putting it into the churn. Now, put fresh, pure water into the churn, a little more than there was of cream and five to ten degrees colder. Close the churn and rotate rapidly. Next draw off the water, straining as before to

catch any particles of butter. If the water is quite milky, wash a second time. If everything has been handled right, the butter is now in small particles and when it is taken out of the churn and placed upon the worker, it rolls out like so much wheat or rather if properly colored, like so much gold.

Working the Butter.

For a farm worker, I prefer a three-cornered table on three legs having a dip towards one corner, and a lever to work the butter. Having weighed the butter and placed it on the worker, weigh out one ounce of salt to the pound of butter; sprinkle it on the butter, best if sifted through a hair sieve, and mix with the granular butter before working. The amount of salt may vary according to the demands of various customers or markets, but the quality should always be good. The object of working butter is to mix the salt thoroughly with it, to give the butter consistency and remove the excess of water. The manner of working should always be by direct pressure, never rubbing or smearing. The amount of working depends upon many points and it is a question for judgment and experience; too much gives a greasy or salvey appearance to the butter; too little may give streaky butter and leave too much water. One working is sufficient if the butter is to be used immediately; but if packed to keep, I prefer two, four to five hours apart.

In putting up for market, make the packages as neat, clean and attractive as possible. The style of package will, of course, depend upon the demands of the market. For immediate use, a pound print or brick wrapped in parchment paper is possibly the neatest and sells best. If to be kept, a larger package will have to be used. Pack the butter solidly, leaving no air spaces. Exclude the butter from the air by having strong brine on its surface and keep in a cool, dark place. Butter is at its best as soon as made, and looses its delicate aroma after a few weeks; so that packed butter is rarely ever as good as the fresh made.

I hope no person will think that I have covered the whole field of buttermaking. I have rather aimed to give general views, which, if acted upon, will be beneficial, and will, I hope, prove also a stimulus to further inquiry.

PROSPECTS FOR DAIRYING IN MONTANA.

By Prof. J. W. Elliott, Agricultural College, Bozeman.

We wish to call attention to the following, appearing as it did in a prominent Agricultural Journal, and referring to Minnesota and giving the reasons why that state stands at the head of the list as a dairy state.

It says, "Healthfulness of climate, pure water, and the fact that the leguminous crops, such as clover, alfalfa, lupines, and the different varieties of peas, rape, and various succulent root crops, grow to greater luxuriance in Minnesota than in localities further south, are the principal reasons why this state (Minnesota, is taking first rank as the dairy region of the continent."

Now let me ask our Montana rancher and thinker to read that statement again to see if he can find one fact that cannot be said and said truthfully of Montana. Then as a second thought, let us consider why it is that Montana with just as favorable climatic and soil conditions as Minnesota, is so backward in taking advantage of this profitable business.

We know of no place on the American continent where leguminous crops can be grown more luxuriantly, where there is a healthier climate, where water of the purest is easier to find, where the market demands are as strong for butter and cheese, and where the price per pound for these dairy products is so high, as right here in Montana.

Montana has almost ideal conditions for the productions of butter and cheese as well as one of the best paying markets on the continent. The question only remains, will the Montana ranchers take advantage of these opportunities.

Unlimited Demand.

Those who visited the State Fair, will probably remember a very prominent exhibit by a Butte butter and cheese commission firm. That firm had on exhibition probably about a ton of butter and cheese. The exhibit was a splendid one, but there was this lamentable fact about it, there was not a pound of either the butter or the cheese that was a Montana product.

On asking the reason the reply came, "If we could only get Montana product we would gladly handle it, but we can't get it," and as a result the citizen of Montana have to pay out in the neighborhood of a million and a half dollars every year, to go into the pockets of producers of other states, which might just as well enrich the purses of ranchers and dairymen of our own state, and thus add to the state wealth.

High Price of Butter and Cheese.

Just stop for a moment to consider the amount of freight that must be paid out every year to bring three-fourths of all the cheese used in the state from New York and Wisconsin; and think of the freight that is paid to place the Minnesota, Iowa, and Kansas butter upon our tables. We may rest assured that the Montana citizen has to pay that freight. There is no use saying that the butter and cheese shipped in is of finer quality than the home product, for we can produce just as fine quality in Montana, as anywhere. And just think how profitable it would be to have that butter and cheese produced at home. We would not only save the expensive freight on these commodities, but we could place a finer article before the people, for it is a fact that the sooner the butter reaches the consumer the more of the fine aroma and high flavor are retained in that butter for the enjoyment of the consumer.

Very Profitable to Dairymen.

Then again how profitable it would be for the ranchers and dairymen and the state in general, to have that one and one-half million dollars retained at home that otherwise is paid to our neighboring states for these commodities.

Too many of our ranchers and farmers are selling the grain and hays off the farm and are getting what they consider fair prices for it, while if they would only buy a few good dairy cows and feed that grain and hay, they would realize double the market prices for their fodders.

We have in mind at the present time a farmer who milks 35 cows the year round, and each one of those cows pays him, over and above her keep, $50.00 clear money. His cows pay him $50.00 each when he only realizes 20 cents per pound the year round for his butter, what then could a dairyman do in Montana with an unlimited demand for butter at prices ranging from 25 cents to 35 cents per pound.

Money Coming in All Year Round.

Dairying, unlike almost every other branch of agriculture, brings in the money every week or month all the year round. The dairyman does not need to wait until he can thrash, before he gets his money, he receives his pay whenever he chooses to take his rolls of butter to market.

Dairyman Sure of His Pay.

Grain or hay crops may fail but it would be an extreme condition when there would not be pasture enough for a few cows. How often it has been, during a drought, or blight, or unfavorable season for grain or hay, that the small herd of cows, that the farmer pays but little attention to, has been the very thing that has carried him over what would otherwise have been a disastrous year.

Nearly every farmer remembers the panic of '93, when the bottom fell out of nearly every market the farmer had. How about butter and cheese in '93? Those commodities scarcely varied a single cent in price. And it is a very noticeable fact that whenever there is a shortage, or failure of crops, or whenever the industrial world has a sudden check the dairyman is the man who suffers least.

The Wrong Way.

It is not dairying to handle our cows as too many of our ranchmen do, that is, whenever they need milk for the table, a "critter" is driven up from the herd and has to be "broke" to milk, then as soon as she gives too little milk to bother with, she is driven back and another "critter" from the herd is driven home to take her place, and she in her turn has to be "broke" to milk.

Of course when ranchers live too far from a market or creamery there is probably a good deal of excuse for this. But we trust that within the next five to ten years Montana will become so thickly scattered over with creameries and cheese factories that there will be ample market for all the milk the ranchers can produce, so that he will then be able to make dairying one of the principal interest of the farm. Farm dairying and an increase in the number and quality of the cows must generally proceed the establishment of creameries.

Evil Effect Upon the Cow.

This plan of milking the cows for a short time, just when they are in the flush of milk, for say three or four months per year,

is one of the worst plans that can be followed, as far as the milking qualities of the cows are concerned. For a cow milked in that manner loses that tendency to produce milk for a long period each year. It is undoubtedly a fact that when cows are allowed to "go dry" before their flow of milk naturally ceases, it tends to produce cows that milk only for a few months each year, when they will go dry in spite of all we can do. Now when the time comes, when we have a market for our milk, and desire those same cows to milk for a longer period it is almost impossible to get them to do it.

The Right Way.

Cows intended for a dairy herd should be milked just as long a time as possible after the first calf. It may be that milking her for such a long time seems very unprofitable, but it must be remembered that the longer we milk such an animal the more are we developing those milking qualities within her that tend toward long milking periods, and the period of lactation in the years to come seem to be largely controlled by the length of time that we encourage the milking period of her first milking year. And more than this, by so doing we not only encourage the production of more milk for a much longer time, but we encourage the production of milk richer in butter fat.

Outlook.

Now we believe and believe strongly that the next five to ten years will see very marked progress in the dairy industry in the State of Montana, and for that reason we would encourage the ranchers to pay a little more attention to the selection and development of foundation stock for a dairy herd.

We do not advise for a moment to buy in high priced dairy stock to form that foundation, but what we do say is, select the best milkers you have and by careful breeding and selection build up a herd of your own. And if each rancher will do that it will be but a very short time before there will be cows enough to start a great many creameries and cheese factories all over the State of Montana.

It does not require such a great number of cows for a cheese factory, for a very successful factory can be run with 375 gallons of milk or about 3,000 lbs. per day and it would require less than 200 cows. A creamery could be run with about 300 cows. Only you want to be sure to have enough cows to produce that quantity of milk all the year round.

HOW TO START A CHEESE FACTORY.

By Prof. J. W. Elliott, Agricultural College, Bozeman.

Frequently we find those living in a section where there are quite a number of cows, who would like very much to see a creamery or cheese-factory started. These people have generally come from sections where the farmers owned such factories and know that they are the best paying branch of the farm work, yet they do not know just what to do to get the farmers interested. So perhaps a few words on how to organize might not be amiss.

Call a Public Meeting

Of those interested. Anyone can do that. And at that meeting determine how many cows there are within a radius of say of 8 to 12 miles, that would furnish milk to a creamery or cheese factory all the year round. In Montana a very successful creamery can be run with 300 cows giving 2½ to 3 gallons each per day, and a cheese factory can be run with 150 cows giving the same amount each. Only remember to have that number of cows all the year around.

If you decide to build, send a committee, say two, of your most practical men, to visit some creamery or cheese factory which is in operation, to find out as to best plans, and best equipment and as to the probable cost of the same. Then at another meeting let this committee report to those interested so they may decide as to whether such an outlay would be a profitable thing for the community. And right here we are safe in saying that where the required number of cows are secured, the farmers will find the dairy business is one of the most profitable businesses to undertake. Quite frequently the busines men will take shares, just to help along, because what is going to benefit the farmers will certainly benefit all.

Location.

The location is one of the most important things to consider, and in deciding this there are three main points to be considered, —first, have the factory centrally located. That is, have it in

the center of the cow population, where it may be reached by good roads, so as to distribute the hauling distance as equally as possible among the farmers. The second point is, have an abundant supply of the purest water. This point goes almost without saying as pure water will materially add to the success of the factory. And the third point is, have splendid drainage facilities. This is absolutely necessary as there is nothing that seems to deteriorate so rapidly and prove such an offense as the waste products from the cheese factory or creamery; so by proper drains have all wash water carried entirely away from the factory.

When Building.

The cheapest, best, and safest plan is to get some practical butter or cheese maker to superintend the erection of the plant and setting up of the machinery. For no man has as proper ideas of convenience as the man who has to work right in the factory. It is his workshop, and he knows when things are handy and convenient and when they are not.

Another point, such a practical man knows just what machinery to order to equip the plant most thoroughly and most economically.

And now, if you have the proper number of cows, and a properly equipped plant, with a pratical man to make your butter and cheese there is no question of a doubt but that the plant will pay handsomely, for in Montana to-day, we have a market to take the entire output of 50 creameries and 15 to 20 cheese factories.

The farmers in other states are growing wealthy through their their creameries and cheese factories and are proving beyond a doubt that, as farmers' co-operations, these plants pay.

Already in this state there are several localities where the people are contemplating building this year. Let this good work go on. It is hoped that other localities will take up this business that will pay to a farmer twice over what he now secures for his hay and grain? Remember the Dairy Department at the Agricultural College is just as anxious that these creameries and cheese factories should be started and started right, as the people possibly can be; and is always ready to help such enterprizes when it is within their power.

FRUIT GROWING IN MONTANA.

By Ass't Prof. R. W. Fisher, Montana Agricultural College.

While many parts of Montana will probably never produce as much fruit as the Bitter Root, Flathead, Yellowstone and a few other favored valleys, yet even in the coldest and highest counties of the state, fruit in sufficient quantities and varieties can be grown to supply, at least the local demand. There is no part of the state in which the grains and grasses are successfully grown, but that will grow fruit of some kind. We now have apple trees that will endure our coldest winters, and ripen their fruit in very short seasons, and the small fruits such as strawberries, raspberries, currants, gooseberries, etc., grow well all over the state, providing they are given proper care.

The farmers in the fruit distiicts do not question themselves as to what varieties will grow, but are concerned more as to how to treat and market the fruits they now have. In the less favored fruit sections the question has been, "What varieties will grow?" and it will be the object of this paper to give briefly the varieties and methods of treatment best to follow.

Many trees have died in Montana, the cause often being ascribed to winter killing, while in many cases their death has been caused by lack of care in planting and after treatment. Fruits planted in an uncongenial soil, or climate, necessarily demand more attention than they would in their natural home, and the lack of this attention is often the cause of failures. And in some cases nurseries have imposed upon the buyers by sending out varieties not true to name, substituting trees not adapted to our conditions; thus discouraging the growers. The only relief from this condition is to order trees from firms of good standing and of known reliability.

Before any fruit trees or small fruits are set out the ground on which they are to be grown should be in the best possible condition of tilth. To grow grain crops, or clover on the ground for a year or two previous to planting fruits is usually a very good

plan. By plowing under a clover crop a good deal of necessary humus is added to the soil, and puts it in a much better physical conditions than freshly plowed sod.

If the trees are ordered from distant nurseries it is best to get them in the fall and heel them in over winter, but when ordered from nearby firms early spring shipment is probably better.

The ground having previously been put in good condition, plant the trees as early in the spring as the ground will bear working. When large orchards are to be set out, it is economy to lay the ground off with a surveying instrument, and plow furrows for the trees, but when only a few trees are to be planted, holes can be dug by hand. It is always advisable to have the trees in straight rows, as it not only improves the appearance of the orchard, but makes cultivating, spraying and harvesting the fruit much easier. The distance apart to set the trees varies some with varieties and localities, but standard and crab apple trees should never be planted closer than 20 feet, while with many varieties from 25 to 30 feet is close enough.

Orchard Sites.

All other things being equal a northern or northeastern slope is best, as on such slopes the ground is not so subject to alternate freezing and thawing, the snow lays on the ground better and longer, and the trees are not so liable to sun scald.

Soil.

The apple thrives best in a well drained sandy loam, but can be made to grow well and produce good crops on a variety of soils, providing it is well drained. The character of the subsoil often exerts more influence on tree growth than the surface soil. Apple trees will not thrive on any kind of soil that is underlaid with an impervious clay subsoil—a soil that holds water for any length of time near the roots.

Varieties to Plant.

This has been a very vital question for many farmers in the state, and many failures are due to the fact that tender or worthless varieties have been planted. In the apple counties of the state, practically all the apples grown in the United States can be grown, with more or less success, but in the districts not so well situated for apple growing we are confined to fewer varieties. Mentioned in the order of their ripening they are: Yellow Transparent, Duchess and Wealthy, which are the best apples

we have for their season in the high valleys of the state. There are a number of other apples that will grow well and produce good crops but I do not believe that any will be found superior to the three above mentioned. For variety, and possibly to suit particular tastes, the Hibernal, Tetofsky, Gideon, Okabena and a few others will be found suitable to the colder parts of the state. The Wealthy is the best late fall apple we have, and by storing in a cold, moist cellar, immediately after picking can often be kept well on into the winter. For a late winter apple I know of no better or more promising variety for locations similar to Gallatin Valley than the Walbridge. The Yellow Transparent is the first apple to ripen and for extremely cold places of short growing seasons is probably the best variety we have. The Duchess is intermediate between Yellow Transparent and Wealthy, and is a good variety for its season.

Even in the coldest and most unlikely places for apples to grow, we can make the hardy crabs thrive and produce immense crops, and for many parts of the state where there is a likelihood that standard apples will not do well, the crabs should be planted. They not only produce a fine fruit for jellies, jams and sauce but are among the most profitable market apples that are being grown in the state. For general planting there is no variety that equals the Transcendent. The Whitney No. 20 is a fine crab to eat out of hand, but is not a profitable apple to grow for commercial purposes, and is not quite as hardy or thrifty as the Transcendent, thus restricting it to less general planting.

A few apples trees supplemented with the small fruits will add much to the pleasure and profit of many Montana farms, on which no fruit is now being grown.

For their season there is no fruit that is equal to the strawberry, nor is there any that will give quicker or larger returns for the time and money expended in growing them. The varieties of strawberries differ in different locations so no one variety can be said to be the best. The varieties that are most generally grown in the state are Warfield, Crescent, Bedar Wood, Bisel, Splendid, Willson's Improved, Haverland, Victor Hugo, and a few others. In places where there are no berries now being grown I would suggest these for trial.

Raspberries and blackberries are the next fruits that ripen and are a class of fruits very easily raised. The red raspberries

are the hardiest and therefore to be recommended for most general planting. Planted in rows five to six feet apart with four to six canes to a hill, 4 feet apart in the rows so as to leave room for horse cultivation, this fruit will bear good crops with but comparatively little care. In most parts of the state it is best to lay the canes down before the first hard freeze in the fall and cover with a little dirt or manure. The varieties best suited to our conditions are Marlboro, Hansel and Cuthbert.

Currants and gooseberries can be grown almost any place, but when given attention in cultivating, pruning, irrigating, etc., they respond very readily, and amply repay in increased fruit production the extra care that is so often withheld from this class of fruits.

The varieties of currants most generally planted and those giving the best returns are Fay's Prolific, North Star and Victoria, of which the Fay's Prolific is the largest berry.

The best variety of gooseberry for general planting is the Downing. It is not so susceptible to the gooseberry mildew that plays such havoc with the English varieties in this state, and should therefor be planted in preference to Industry and the other varieties of English origin.

Q. Which is the better adapted tree for Montana, the low or high headed tree?

A. Low headed trees are much better for practically all locations in the state. Such trees are not so liable to sun scald; they can endure, without injury to tree and fruit, stronger winds, and the tree is much more accessible for spraying and gathering of the fruit. We have modern cultivating implements that can be spread apart from the center so as to get near the trees in cultivating. Trees headed from the ground to 2 or 2½ feet are the best. Many growers preferring to have the trees branch at the ground.

Q. What is the best aged apple tree to transplant?

A. A tree two years from graft can be transplanted with less loss of roots, and in some cases gives better results than older stock, such trees are straight and may be headed by the planter at any desired height. But frequently three-year old trees are best, and are the size usually transplanted. Such trees have the heads already formed in the nursery row, and in that respect are sometimes not so desirable as two-year stock. But usually trees can be handled better when young in the nursery, and unless

special care is given the two-year old transplanted stock the three-year-old trees are to be preferred.

Q. When is the best time to prune fruit trees?

A. When the trees are in a dormant state. In Montana, March and April are the best months, but pruning may be done at any time if necessary, and unless too much is cut out no damage will result.

Q. What is a good covering for large wounds?

A. A thick coat of white lead is about the best and most easily applied covering for wounds. It acts as a protection to the wood preventing the cambium and wood from drying out and checking, and is also a good antiseptic covering, thus preventing in many cases fungus growths from getting a foot hold.

Q. Have we in Montana a strictly first-class winter apple?

A. I think the general concensus of opinion is that we have not. And it opens up a very fertile field for originators or growers of seedling apples.

Q. Will mulching retard tree growth in the spring?

A. When the top of a tree or shrub is exposed to the influence of the weather, mulching when it only covers the ground, will not retard the growth to any appreciable extent. The mulch is beneficial in that it keeps the ground frozen and prevents alternate freezing and thawing, and on shallow rooted plants it may exert some influence on the top growth.

Q. Why is it best to graft below the surface of the ground?

A. This kind of grafting is what is known as root grafting, and is done on small stock. The reason why it is better to have the graft below the surface is that a cion of known hardiness is placed on a stock of root of unknown hardiness and by having the union below the ground only the hardy cion is exposed to the weather. And it is often desirable to have trees on their own roots, and by placing the graft deep in the soil the cion will eventually take root, at which time the old stock usually dies. The place where union takes place is often enlarged and would be unsightly to have above ground. And by having the graft in the ground the damp earth acts as a protection until union takes place.

Q. In top grafting large trees is it best to cut off all the top the first year?

A. No. In working over old trees it is best to extend the

work over two or three years. Too severe pruning of the top has a bad effect upon the life of the tree.

Q. Is top grafting better than budding?

A. For certain trees it is. Apples and pears are usually grafted, and for these trees grafting has many advantages over budding. Budding is sometimes employed on apples and pears when the cions are very scarce. By budding, a growth is gained from a single bud while in grafting two or three buds are used. On trees with a thick bark union will take place quicker from a graft than from a bud.

Q. What is meant by intensive cultivation?

A. Cultivation that keeps the ground frequently and thoroughly stirred.

Q. How often is it necessary to irrigate orchard trees?

A. That depends upon the season and the locality. Usually one irrigation is sufficient if thoroughly done. The method practiced here is to irrigate the orchard thoroughly in June or the first of July, and then cultivate at intervals of a week or ten days up until Aug. 1st. In some parts of the state where the atmosphere and ground are very dry during the winter months a late fall irrigation is no doubt of much benefit.

Q. How much water is it best to apply at one time?

A. Enough to wet the ground as deep down as the roots extend. Surface irrigation probably does as much damage as good. For orchards furrow irrigation is best.

Q. When berry bushes are laid down in the fall how deep should they be covered?

A. A thin covering is all that is necessary. The object is to keep them frozen, until danger of severe freezings are past in the spring.

Q. Will trees grow upon alkali soil?

A. Not usually. As a rule trees are very susceptible to the bad influences of alkali soils.

SOME PESTS OF NURSERY STOCK.

By N. E. Brandegee, Pres. State Board of Horticulture, Helena.

With closer relations between communities comes an interchange of animal and vegetable life. Whether there is reciprocity or not in trade, there is a swapping of weeds and vermin. Noxious plants and insects are adapted to particular modes of travel, and in civilized states, if unrestrained, soon establish themselves wherever environment is favorable. In greenhouses of the north to-day can be found scale insects of the East and West Indies and root parasites that eat tea in China and peaches in Georgia. Out of doors is a cosmopolitan array of insects and fungi. More than two-thirds of the weeds of any community in the northern United States come from abroad. More than this proportion of the most injurious insects probably are not native. Few of our cultivated plants are native to the country but have been supplying food to civilized man from the beginning of the agricultural stage. They were brought to this county by the white men and along with the plants came insects and other parasites that use them for food.

Of all methods of travel of horticultural pests the most usual is nursery stock. The distribution of these is well illustrated by the spread of that most famous insect in all the world's history—the San Jose scale. It came from China and was planted on some Chinese trees at San Jose, California. In 1889 it was reported on as extremely injurious and the fruit raising sections of California were warned of its dangerous powers. Notwithstanding this, its spread in that state was rapid and also the states north became infested. In 1887 it was sent on some scions to a nursery in New Jersey. There it flourished but unknown to the owners. For six years it was distributed over the eastern states and not till 1894, too late for eradication, was its presence detected. It has then firmly established itself in nearly all those states.

The rapid spread and the deadly character of this pest—living on nearly all trees and killing fruit trees quickly and even de-

stroying entire orchards—became thoroughly known and all fruit raising districts were alarmed and fearful for the future of their industry. The fear extended to nearly all states of the Union. Legislation was resorted to by nearly all of them. Laws were passed requiring inspection of nurseries, the fumigation of nursery stock and the inspection of fruits in the market.

The San Jose scale was and is a very destructive insect. It threatened for a time to overrun the whole country. It is perhaps the most insidious insect that was ever introduced into a country. But its spread is not an anomally. Similar invasions have occurred and the balance of things has been disturbed by grasshoppers, and the Colorado potato beetle and other pests. But if nature never allows one good quality to usurp the world she is not more lenient to a bad quality and does not permit it to dominate for long. Parasites after a while become more abundant than the scale. Better methods of fighting it were devised. In California to-day the San Jose scale is not regarded as one of their most injurious insect pests and Oregon and Washington are becoming as free. The lime, sulphur and salt spray has proved very effective in those states and with certain modifications is proving effective in infested communities east. Four years ago it was a difficult matter to find cars of fruit in this market free from the San Jose scale; now it is rare that a specimen can be found.

The San Jose scale has not been found in Montana and should not be feared if found. A new and a bad insect was this contribution from China, but it has not so far proved an unmitigated evil. It was destructive and is destructive but it aroused the country to a realization of the destructiveness of horticultural pests as nothing else has or could arouse them. It has improved the standard of commercial fruit over the country and directed the energies of people to saving the losses that occur each year on account of insects and fungi.

The inspection and fumigation of nursery stock which now prevails in nearly all states of the Union was a direct result of the excitement caused by the San Jose scale and was primarily intended to prevent the spread of this insect. Fumigation is a complete remedy, on nursery stock. It destroys this insect and a host of other parasites. The list is too long, even to be enumerated here, those that come into Montana. Suffice it to say that this remedy is a necessary one at the present time for

all orchard trees and the young orchards of Montana are likely to be freer from parasites as a result of this fumigation.

But fumigation does not kill all insects in the egg form. It would not be effective against aphis except in later shipments, nor against, for instance, Oyster Shell Bark Louse nor the Scurfy scale. The inspection of nurseries, however, is ridding nurseries of pests also and it is probable that very little more of the scale insects will get into Montana.

Fumigation is not effective against fungi but is a total failure here. Apple scab has shown itself around Flathead Lake and apple canker in the Bitter Root. The black knot of the plum flourishes on wild cherry in the Gallatin Valley. A serious currant cane blight (Nectria cinnabarina) has appeared near Great Falls. Nearly all these troubles were introduced years ago. They are not nearly as serious as in moister countries. Even around Flathead lake apple scab does not flourish. The black knot of the plum, however, should be destroyed with the young tree where found. The fire blight of the pear has not to my knowledge been found in Montana. As it destroys 70 per cent of the pear trees west of us and favors a dry climate its presence is to be feared in this state.

Root parasites are after all the most insidious foes with which we have to deal. Scale insects, even minute as they are, can be gotten at and effectively dealt with. So can the black knot and so will finally pear blight, for the disease is above ground and branches can be destroyed. The wooly aphis, which lives on the outside of the roots, making galls on them, from the fact that it is in this form below the ground is harder to reach. It is distinctly a nursery stock insect and trees infected with it are always destroyed by inspectors. Montana, however, is singularly free at the present time from wool aphis. On one old tree at Missoula the insects occur and flourish but the tree does not seem to be much injured by them.

There is a root disease, however, that is most insidious in its nature from the fact that it attacks the tissues of the root, and any remedial measures would immediately destroy the tree. This disease is known as Crown Gall. Peach, pear, plum, apricot, almond, walnut, grape, raspberry, blackberry, cherry, poplar and chestnut are all affected by it and the disease in all is primarily the same. It may be known by a swelling of the tree at the crown and by smaller swellings on the young roots. This

disease has occurred for years in American nurseries and was formerly regarded as caused by the imperfect union of stock and scion. It occurs on seedlings, however, and on smaller roots and sooner or later kills any young tree attacked. Prof. Toumey of the Arizona Experiment Station published in 1900 a series of experiments with the germ of the disease and since that time more trees have been destroyed over the country for Crown Gall than for all other diseases combined.

The disease is caused by a slime mould fungus and is closely related to the germ which causes the club root of the cabbage. No other fungi of its class are parasitic so far as known. It is primarily a nursery trouble and has been widely distributed by infected nurseries sending stock over a wide area. A single infested nursery can be the means of infecting a whole state and perhaps several states. The disease is obscure and often is difficult of detection. The swelling at the crown is not always present and smaller swellings on the roots are less frequent. Sometimes the roots exhibit the characteristic spongy texture without galls on crown or roots. Sometimes galls are present on the roots and the crown is normal. Sometimes the crown bears the unmistakable gall and the roots are smooth. The galls are of a warty and spongy nature and tend to be round, unlike galls made by wooly aphis, which are oval and smoother. The galls become the abode of animal life and decay rapidly in the soil. When nursery stock arrives the galls may have previously decayed in the soil or have been removed from roots leaving only a rotten condition of roots that arouses suspicion hard to confirm.

So widespread is the disease however, occurring over the entire country and in nearly all of its nurseries, that at the present time all the state can do is to demand that no tree with galls on the roots shall be sold. Thousands and tens of thousands of such trees have been condemned in Montana, and the rigid inspection of nursery stock has probably saved the planting of 50,000 such trees in the last two years. Some diseased trees have probably yet escaped condemnation. Any orchardist planting young trees should personally scrutinize all their roots and see that they are free from galls of all kinds. Galls made by wooly aphis and Crown gall also render any young tree worthless.

And they are worse than worthless when infected with Crown gall. An orchardist may plant a tree so diseased and it may live and grow. He prunes it, cultivates it, irrigates it and hopes for return after a number of years. But the tree is sure to die before it bears fruit. Did he lose only the original cost of the tree the case would be bad enough. But he may lose also land and labor for a number of years and harvest nothing but disappointment.

The disease spreads rapidly in the nursery row and it may spread from tree to tree in the orchard. By planting such trees a disease of a highly contagious character is introduced. While in states where irrigation is not practiced the disease is regarded as serious, in irrigated plots it is much more dangerous. The germ is carried by the water all over the ground. Arizona and California report large losses of trees from this cause and it seems as destructive in Montana. I have seen thousands of trees in the ground that were slowly dying from it. Larger trees are affected and some cases of broken trunks and broken branches are due to devitalization from Crown Gall.

About three hundred thousand young trees are planted each year in the state of Montana. It is of the utmost importance that these so far as possible should have a good chance for life and usefulness. What the proportion of fruit trees planted in Montana that have lived to bear fruit is, is a matter of conjecture. I have heard it placed as low as 10 per cent. It varies with individual planters, with localities, and the nurseries from which it comes and the varying conditions in which it arrives.

Whether the estimate is high or low it is certain that the proportion will be much higher with inspection and fumigation of nursery stock. Not only will home nurseries be kept clean of all infectious diseases and noxious insects but Montana will not be a dumping ground for trees that cannot be sold elsewhere.

FRUIT GROWING IN MONTANA.

By President Harlan, Como.

As President of the State Horticultural Society I have been requested by the Institute Board to accompany the party in its trip through this part of the state in the hope that a greater interest might be aroused in fruit culture, and to aid in so directing the first efforts in tree planting that fewer mistakes and more success might follow.

But before taking up the subject of fruit growing a few words may not be amiss calling attention to the relation of Agriculture and Horticulture to the permanent welfare and prosperity of the State and its people. Mining, which is often called the greatest industry of the state, is in its nature more or less transient. To-day, or this year a mining camp may be in its prime, employing much capital and hundreds or thousands of laborers and furnishing a ready market for large quantities of goods and the products of others' labors. But in a few months or a few years at most, the mines will have been worked out, the camp partially or entirely deserted and able to furnish little or nothing toward the support of its former residents, the surrounding communities or the State.

The truth of this is shown by noting the many half-deserted or abandoned mining camps and towns in the mining regions of the west.

Agriculture on the other hand is as permanent as the hills and valleys themselves. A farming community or a town or city supported by the farming interests tributary thereto is there for ages, always contributing its full share toward the support of the State and the happiness and well-being of the individual.

Every agricultural community and town in Montana is to-day prosperous and actively growing. Business blocks and dwellings are being built. More school houses, churches, public libraries, bridges, water works, lighting plants and street car lines attest their permanency and prosperity.

But agriculture itself is not at its best where diversified

farming does not obtain. The man who confines himself to raising cattle or sheep or hay or grain alone is not doing the best for himself, his family, the community or the State. The cattle or sheep ranch, isolated as it generally is, with no attempt at adornment, with no surrounding trees or shrubs or flowers, with no vegetables or berries or fruits, is not the best type of American farm or of home life. The owner himself is not satisfied with it and does not expect to make it his permanent home, and just think of keeping or raising a family amid such conditions. The farmer who raises nothing but grass or grain is but little better off so far as a true home is concerned. Compare such camps with the farm home that is surrounded by shade trees and ornamental shrubs and vines and flowers, where the housewife has a vegetable garden from which she can get fresh vegetables for the table, not only the potatoes and cabbages and onions that might have been bought in the distant town, but also in their season the peas and beans and corn and tomatoes and many other garden products fresh and crisps. Then add to these for the mother and the children and the men folks as well, a plentiful supply of strawberries, currants, gooseberries, raspberries and blackberries which can be so easily raised upon every farm in Montana in the greatest abundance and excellence. And then to all this add an orchard of cherries and plums and of apples at least sufficient for home use the year round, either fresh or canned and you have a home in the truest sense of the word—one worth living for, one worth fighting for, one good enough to die upon. With such homes as this, fewer farmers' wives would be found in the insane asylums. With such homes as this the problem of keeping the boy upon the farm is solved. I have mentioned nothing but what every farmer in the Yellowstone or Milk River valley can have and I hope and trust in time will have and when he has such a home he will quit longing for a return to what he may call "God's country" in the far east and find that he has a "God's country" right here and in his happy content will be a better man and a better citizen.

Now as to berries, they can be so easily grown upon any farm in almost any section of Montana that there can be no valid excuse for any farmer doing without.

It is not possible for a Rockefeller or a Vanderbilt to procure with all his wealth a more lucious dish for his table than any owner of a small plat of land can get each day for a month or

more from his bed of Montana grown strawberries. The catalogues list dozens of varieties, but they are all good and the poorest is far better than none, while some of the newer kinds are beautiful and lucious beyond description. In no state do they do better or are more easily grown than here.

The same is true of currants, gooseberries, raspberries and blackberries. The latter may need to be laid down and covered in the fall in some of the more exposed and colder portions of the state, but that is quickly and easily done, and the little trouble and labor involved should not stand in the way.

Now as to standard or tree fruits. There are but few places in Montana where at least the hardier apples can not be grown while in most of the farming valleys a good assortment of apples, cherries, and plums may be had for the planting. A few failures in any locality do not prove that fruit can not be grown there. If they did, no orchards would to-day be found in the Bitter Root Valley or in many other fruit growing sections, for failures were frequent and discouraging at first from avoidable causes.

The first requisite in tree culture is to obtain varieties that will be hardy and stand the winters in that locality. When that is done success is assuerd for good common sense and hard work will do the rest.

In the Bitter Root Valley almost any of the varieties grown in the Eastern and Northern states are fairly hardy, but in many of the valleys of the state which are colder, those especially hardy should be selected.

Among the hardiest kinds of value I will mention the following: Yellow Transparent, a very beautiful apple of fine quality, ripening in August and best for home use and near-by markets, but too tender in flesh to ship long distances when ripe. Next comes Duchess, a perfect apple for its season, September and October. It is entirely hardy, prolific, large, highly colored and of good quality for eating and cooking. For October and November we have the Wealthy, a high colored, high flavored apple, very productive, hardy early bearer and a good shipper but should not be kept late into the winter as it is apt to shrivel and lose in flavor. For the same season we have Alexander, very large, an attractive apple but not so good in quality, but as hardy in tree. Our best mid-winter variety is McIntosh Red, very fine in appearance and quality but not quite so hardy in tree. Antonovka is

a winter variety, very hardy in tree, large, yellow and good quality fruit. Scotts' Winter, Northern Spy, Gano, Bethel, Isham Sweet ,etc., will keep until spring and are hardy. The above are about the only kinds that should be planted at first unless other varieties are planted for experimental purposes.

Of plums, Wolf, Wyant, DeSota, etc., being select wild plums of Wisconsin and Iowa origin, are good and hardy. Among the larger kinds Lombard, Bradshaw, German Prune and some of the Russians will probably do well.

As to cherries, such Russian varieties as Vladimer, Bessarabian, Wragg, Osthirim, etc., are far better and hardier than Early Richmond. I have found no fruit more satisfactory than the Russian cherries.

The Flemish Beauty pear is the hardiest and is good. Next comes Clapps' Favorite and Seckle with Bartlett and Lawrence coming close in hardiness.

Right here let me give a word of warning against the irresponsible tree peddlers. While there are many, very many, reliable nurseries, and many agents selling trees who are honest and upon whose word dependence can be placed, yet it is too true that a large proportion of the traveling tree peddlers are the veriest rascals unhung and if their swindling operations were against any other class of business men they would soon be lodged in the penitentiary, but the farmer seems to love to be humbugged for he simply complains and does nothing toward arresting and prosecuting the scoundrels. By dealing only with reliable and well-known nurseries and their fully accredited agents, but little risk is taken, but beware of those smooth Ephraims whose sole stock in trade is a glib tongue, a book of highly colored pictures and some big specimens in glass jars.

Any good well-drained soil is good for an orchard. Do not plant on low, wet or mucky soil nor, if possible to avoid it, on land too rocky to cultivate easily. Land that will grow good crops of wheat or potatoes will grow fruit.

Plant young trees, preferable two-year-olds. Head them low both for hardiness and convenience in picking. Remember the trunk or stem of a tree is the least hardy part of it.

Do not plant trees too close together, not less than 20x20, and 25x25 is much better, although when the lay of the land will permit, it is a good plan to set trees 18 or 20 feet apart in the row running north and south with the rows 30 or 33 feet apart.

thus giving a good number of trees to the acre and allowing the sun to shine on both sides of the trees and giving plenty of room for cultivating one way and drive-ways for wagons while gathering the crop.

Until the trees are in full bearing at least, it is necessary to cultivate the land during the spring and early summer months, not allowing any grass to get a foothold. After midsummer it is better to stop cultivation to allow the wood to ripen thoruoghly before a severe winter.

Vegetables may be grown between the rows of trees to advantage, but never grain. Nothing will so injure a young orchard as grain grown among the trees.

Trees should be irrigated, the same as any other crop, when they need it. Do not follow an iron-clad rule as to stated times or periods but water when and as often as the soil and trees show the necessity for water.

After the trees have arrived at full bearing age, say 10 or 12 years after planting, clover may be sown in the orchard, provided always that plenty of water is given both clover and trees, not otherwise. But the clover should not be cut and hauled off for hay but allowed to rot upon the ground thus enriching the soil and forming a mulch that serves to keep the surface moist and mellow.

Little pruning is necessary until the trees come into bearing, and the old advice never to cut off a limb unless you have a reason for it is good advice still.

The large questions of the best methods of harvesting and marketing the crop can safely be left for future meetings. This paper having been written more for the purpose of encouraging the planting of trees in sections where few had been planted before and giving simple directions for the planting and care of young orchards.

If my efforts should have the effect to stimulate the desire for planting trees and result in more farm houses being surrounded by small orchards all over our state, I shall be well repaid. Speed the day when every Montana farmer shall be a fruit grower also.

DISCUSSION AT BILLINGS.

J. D. O'Donnell. Several years ago I planted 100 trees in good soil and the first year they made good growth, but the

next year all winter killed. Later I planted 100 trees on new land and they all died. Could you account for this?

W. B. Harlan. Not without fuller knowledge of conditions.

I. D. O'Donnell. I think that orchards here need protection in the winter. I have in mind an orchard planted very thickly that survived and did well while others thinly planted died. What do you think of this, or of the advantage of a wind-break?

W. B. Harlan. We do not need wind-breaks in western Montana, but you may need them here where the winds are stronger. We think the Chinook winds are more harmful to our trees than such blizzards as we have.

Q. Our surface soil is mellow but at 6 inches there is a hard layer. Will this bother the trees?

W. B. Harlan. Six inches is pretty shallow if all the roots must remain therein. But most subsoils will admit roots if tree is healthy and vigorous enough to push them strongly.

Q. Would dynamiting the soil be helpful?

W. B. Harlan. Have heard of its being used to advantage in digging holes for planting trees.

Remark. In Colorado this kind of soil is dynamited with much success it is thought.

Q. In a young orchard when would you start to guard against insect pests?

W. B. Harlan. Be careful that such pests as codling moth and San Jose scale are not introduced. Be sure that the trees are clean when imported and then do not permit old fruit boxes to be brought from town to the orchard. Such pests as aphis, tent-caterpillars, etc., can be guarded against but only fought after their appearance.

Q. I have been told that it is practically impossible to set out trees successfully in the raw or new prairie soil. What do you think of this?

W. B. Harlan. New bunch grass land is as easily prepared for trees as old land and of course just as good, but it is hard work and unsatisfactory to try to prepare tough sod for tree planting.

Q. How far apart do you set your trees?

W. B. Harlan. Most trees in the Bitter Root were set 16x16 thought it is now conceded by nearly every one that it is much too close. 20x20 or 24x24 is near enough. I have trees interlacing at 30x30. A good way is to plant them nearer together

in rows running north and south, but wider between the rows, thus giving room for cultivating and training.

Q. What age should the trees be when set out?

W. B. Harlan. One, two or three years old. As a rule the more experience one has, the younger the tree he will plant. A young tree will cost less, be more easily planted, grow quicker and better and come into full bearing just as soon as an older tree.

Q. Have you been troubled with root borer and how would you destroy it?

W .B. Harlan. We have the native flatheaded borer that sometimes troubles trees the first season after planting, but not afterward if killed then, as it may be by cutting out with a knife.

Q. What is the proper time to pick fruit?

W. B. Harlan. When it is fully ripe and well colored and if possible just before it drops to the ground which some varieties are prone to do as soon as ripe. Better let some drop than pick all before fully ripe.

Q. How would you store apples in the cellar, in a box or otherwise?

W. B. Harlan. In boxes nearly full and piled one on top of another nearly to the ceiling.

Q. I have noticed that the Gideon apple keeps better in the Bitter Root valley than here. Why?

W .B. Harlan. Can't say, unless your warmer summers ripen it earlier.

Q. When I pruned last spring I noticed my trees had a black heart. What do you think of this?

W. B. Harlan. Caused by cold winter, but probably will be no serious injury as the life of a tree is in the bark and outside wood and trees will live and bear many years while the heart is entirely rotten.

DISCUSSION AT GREAT FALLS.

Paris Gibson. Does it do any good in planting young orchards to wrap the stems of the trees with burlap to protect them from the winter's snow and also to mulch the trees?

W. B. Harlan. The wrapping is beneficial if it is done with the right material. It does not protect trees to any great extent. We used to do it but do not now. In the winter it protects the

trees from sun scald which with us kills more trees than any disease. It is the continued thawing and freezing that injures the trees more than continued freezing. Mulching I do not think is of much value. When you come to advise mulching you lead people astray. They will pile manure around the body of a tree and there is no more certain way of killing your trees. The roots are made more tender and during the summer they get close to the surface and scatter to some extent and next winter the roots are near the surface and they are more easily killed. A mulch should be made by cultivating the soil and keeping it mellow.

Paris Gibson. If the tree is to be wrapped what material should be used, is common burlap sufficient?

W. B. Harlan. Yes, it is sufficient, but if you have a large number of trees it is a good deal of trouble and expense. There is a vegetable fibre you can get for about $1.00 per hundred that is already prepared. It is just the right size and if the job is carefully done it will keep the rabbits and even the mice away.

Remark. Some of our nursery men claim that if you mulch a tree every year before the ground is thawed out that this mulch keeps the frost in the ground and the tree does not bloom so early, and it prevents the freezing of the early blooms.

W. B. Harlan. Those who make this statement are not well posted. It does not affect the blooming and budding of a tree whether the roots are frozen or not. We have tried it many times. There is enough sap in the upper part of the tree to make it bloom. There is no connection between the roots and the blooming of the tree.

W. M. Wooldridge. When you people began growing fruit did you not have doubts whether it would grow.

W. B. Harlan. Yes, we were told it would not grow.

W. M. Wooldridge. When you did plant didn't you plant the hardiest varieties?

W. B. Harlan. At first we did not plant hardy trees because they were not introduced. At first we used those that grew in New York and Ohio, but they were soon killed. Our hard winters that kill trees come only about every 12 or 15 years and most anything will grow until one of these winters comes along. The trees are not absolutely killed, but they are rendered useless for a number of years.

W. M. Wooldridge. You said thawing and freezing injured trees more than continuous cold weather.

W. B. Harlan. We think so. However, where the cold is long and intense the sap is dried out of the trees so that they suffer to some extent.

W. M. Wooldridge. I believe one of the greatest curses to tree culture in these outside nursery men coming in and selling trees under all sorts of misrepresentations. The next year they are gone and they do not care whether the trees live or not. There is a very small per cent of these trees not killed when growing. In the Milk River valley at least $14,000 worth of trees have been sold and of these fully 80 per cent died. This gives the general impression that fruit growing is a failure in that country. I am glad to say that this spring we have Montana nursery men in there and they went in with the idea that it means business in the future if the trees grow.

They have even recommended against planting extensively. The outside nursery men try to secure as large orders as possible. The Missoula nursery and Falthead nursery are represented in that section. I look for far more favorable results this year.

Remark. I would like to know what are the hardiest varieties of apples.

W. B. Harlan. It depends on the season in which they mature.

Remark. Well winter apples.

W. B. Harlan. I have found no winter apples that are thoroughly satisfactory. The hardiest trees are the early varieties, almost universally so. There are two or three varieties which are hardy and are winter varieties such as, the Hibernal. This is as large as the Alexander and looks like it. It bears early and heavily but the skin has a bitter taste that prevents its being a good eating apple. The Autonovka is another that is pretty well distributed in our country and is very hardy. It is a large yellow apple. Then the Bethel that keeps until about this time, May, and is hardy. It is classed as one of our iron clads.

Remark. What is the hardiest apple for any season or any place, early or late.

W .B. Harlan. The Whitney, No. 20. is the hardiest of any we have but the season of the fruit is very short.

W. M. Wooldridge. How is the Wealthy?

W. B. Harlan. Not so hardy, but still it is what we call an iron clad variety. I have found that we can raise trees very much better than they can in Minnesonta.

Remark. In planting orchards would the trees be likely to grow along, and next to creek bottom. It is not very wet; wouldn't that be a better place than a side hill?

W. B. Harlan. I do not know as to the conditions here where you do not irrigate, but you do not want to get into a wet creek bottom. Apple trees cannot stand wet feet.

Remark. This is where anything will grow. It makes good garden. That ought to be all right. Land that will grow good potatoes ought to grow good apples.

C. H. Campbell. How about setting seedling trees thick and thinning them out afterward.

W. B. Harlan. I have never found a man who had courage enough to cut bearing trees out.

C. H. Campbell. It seems as if setting them thick would protect the others.

W. B. Harlan. I think the best way is to set trees thick in rows only one way and far apart the other.

Remark. Do you get heavy southwest winds that blow for several days at a time in the spring, or at all seasons.

W. B. Harlan. We have what we call the Chinook.

W. M. Wooldridge. I notice in northern Montana the general prevailing opinion is that where there are trees the blossoms will be blown off by the wind so that you would not get any fruit. One of the difficulties with Montana trees is that they bear entirely too much fruit. Very few have courage enough to thin out fruit. I do not believe there is anything in Montana that injures trees more.

Remark. There is a tendency for the wind when it keeps on blowing to blow the soil away and if you look at a tree at the end ot a season there is a little circle arount it where the wind has blown the soil off.

W. B. Harlan. In planting young trees make a small mound of soil around them. I have never heard of a wind strong enough to blow blossoms off a tree. We often welcome a frost that will kill half of our blossoms.

Remark. Do you advise wind brakes around an orchard?

W. B. Harlan. We do not do it. We have no use for them. It might be necessary on prairies.

DISCUSSION AT HARLEM.

W. M. Wooldridge. How about severe cold injuring apples on the tree?

W. B. Harlan. I have had apples frozen solid and when they thowed out they were apparently uninjured. After having frozen and thawed out three or four times it begins to tell on apples.

W. M. Wooldridge. What is your latest killing frost in the spring? The first one in the Fall in the Bitter Root valley.

W. B, Harlan. That depends but it is usually safe to set out tomatoes, the 15th or 20th of May. Sometimes it freezes as late as June 1st. You need not be afraid of a light frost killing blooms on apple trees. 23 degrees injures half or more of the blossoms, but it is a good way for thinning them out.

Remark. Do you recomend mulching in the winter?

W. B. Harlan. Well hardly. For an amateur it is a good way to kill trees. To put a mount around a tree does not do any good.

Remark. Does alkali have any effect on trees?

W. B. Harlan. When it is very strong trees do not do well. It is about the same as with grain. Late irrigation and cultivation are not to be recomended because of the late growth that is induced. Trees must go into winter quarters absolutely dry.

W. B. Sands. To what do you attribute failure at first?

W. B. Harlan. Lack of care and understanding in handling young trees. The ground should be plowed deep and well cultivated. It should be loose and mellow.

Remark. I have apple trees about 8 years old. They are on the bank of a ditch. They bloom every year and the blossoms fall off but there are never any apples.

W. B. Harlan. Are there any other trees near.

Remark. No.

W. B. Harlan. That is the trouble. They need cross-fertilization.

DISCUSSION AT MALTA.

Mr. Stevens. What do you think of the success of fruit raising on the particular kind of soil we have in this valley? The climatic conditions are not much against it, but how about the soil?

W. B .Harlan. Without any experience here I cannot say.

Only by reference to the soil conditions in the Bitter Root valley. We have as many kinds of soils as you have. We raise apples in almost all kinds of soil.

DICUSSION AT HINSDALE.

W. M. Wooldridge. What variety would you recommend for this section? (Hinsdale.)

W. B. Harlan. I think among the early varieties the Yellow Transparent comes first. It is hardy, early to come into bearing, ripens in the month of August. It is a magnificent apple in appearance when cultivated and when it ripens upon the tree there is no better apple that grows. For home use it is especially fine. Next comes the Whitney which is a small apple sometimes classed as a hybrid crab. It is one of our hardiest apple trees. It ripens in September, but will keep under ordinary conditions only twenty or thirty days. There is no apple children like better than this. The Wealthy comes next and the Duchess. These are absolutely hardy, large, have fine color, and are good for cooking. The large Alexander apple is desirable, but not so good as the Wealthy. It is very large and excellent in many ways. The Russian Hibernal is absolutely hardy.

W .M. Wooldridge. What effect has late frost in the spring and early frost in the autumn on apples.

W. B. Harlan. There is no danger. I have never lost a crop of apples by spring frost. I have lost blossoms, but I was thankful for it. In the fall I do not know whether our freezing weather is later than yours or not. We gather our apples from the 1st to the 10th of October. We have lost only a few apples by freezing and thawing. One year we lost some about the 15th of October. They will stand a certain degre of frost and especially if followed by a cloudy day. Continued freezing and thawing injures apples.

Remark. I would like to ask about mulching trees.

W. B. Harlan. Why do you wish to mulch? For what purpose?

Remark. To keep them from thawing in the spring and to keep the blooms back.

Remark. Is there very much danger in giving trees too much water when they are young.

W .B. Harlan. You have to treat them as you would any

other crop, with intelligence. I do not think there is any danger of giving them too much water except when you flood the ground and let the water stand. They will not live with wet feet. Treat them like a hill of potatoes and you will be alright.

Remark. Is there any difference in the nursery that the trees come from?

W. B. Harlan. I do not think there is enough difference to be noticable. We thought that at first but upon experimenting we have found no difference.

TOP GRAFTING OLD ORCHARDS.

By R. W. Fisher, Montana Agricultural College.

In many orchards of the state, especially the older ones, and the young orchards in the new fruit districts we often find unproductive trees that yield an inferior quality of fruit. And while the trees are hardy, thrifty and vigorous, yet they are a source of discouragement on account of their unprofitableness.

The most general reasons why such trees are found are: (1) Nurseries have sent out varieties not true to name; (2) The planters, not knowing the best varieties have ordered inferior ones; (3) Seedling trees have sprung up making good trees but producing poor fruit. And we also have many excellent apples that do not thrive on their own stock or stem on account of susceptibility to sun-scald and other weaknesses. Another condition that calls for changes in many of our orchards is the prevalence of entirely too many varieties in one orchard, or even in the same locality. So many in fact, that the growers find apples unprofitable on account of not having a sufficient quantity of any one variety to warrant a shipment to distant markets.

In order to overcome these many difficulties, it is a very slow process, and one not to be advised, to cut down such unprofitable trees and plant new ones of the desired variety; and this brings us to the object of this paper; top-grafting or top-working.

This can be successfully done whenever we have good healthy stocks on which to place the grafts, and the new scions or grafted stock will produce fruit from 2 to 3 years after they are set on

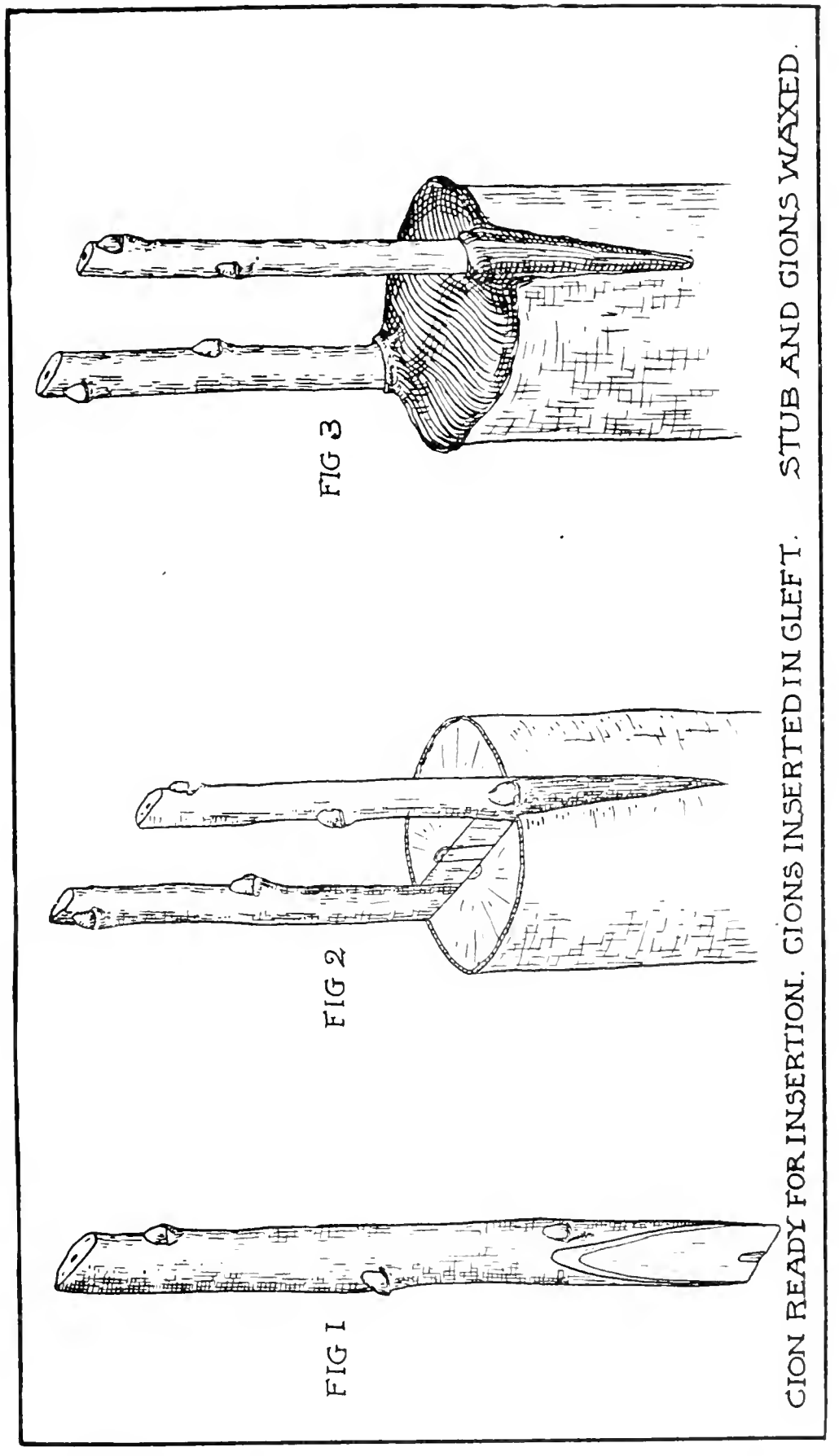


FIG 3
FIG 2
FIG 1
CION READY FOR INSERTION. CIONS INSERTED IN CLEFT. STUB AND CIONS WAXED.

old trees or trees of bearing age. This operation is best done about the time growth starts, but can be done a month earlier or later when necessary. The method almost universally used in top grafting apples and allied fruits is what is known as cleft-grafting. (See illustration.)

The stock or limb on which the graft is made is cut off square, and a cleft 1½ or 2 inches made in it with a sharp thin bladed chisel or knife, care being taken that a smooth cut be made, and that the bark is not torn. The scion or variety that is desired to graft is cut, with usually 3 or 4 buds, wedge-shape, having the outer edge of the wedge a trifle thicker than the inner, so that the cleft will grasp it the firmer and hold it in place better. The lower bud or the bud where the wedge starts is placed about at the surface of the stub, and the entire wound covered over with grafting wax. Sometimes it is advisable to wrap the wound with twine or cloth to insure the scion being held in place until the two grow together but in a good graft properly covered with grafting wax this precaution is not necessary.

On stubs one-half inch or more in dimension, two scions are inserted, one on either side. This not only doubles the number of scions, and likewise the chances for a growth, but also helps in the healing process. If both grow one can be cut out after they have developed enough to insure the growth of the scion. The one important think in making the graft is to get the inner bark or cambium layer of the scion in contact with the cambium layer of the stock, and if this is done and the proper precautions taken to prevent them from drying out there is little danger of them not growing.

In large trees that need much pruning of the original top it is better to prolong the grafting over two or three years, as cutting out the entire top in one year will sometimes kill the tree or give it a very severe check, either of which are to be guarded against. But the limbs to be cut out and grafted should be decided upon at once and cut out as soon as the tree will stand it.

To be most successful in top-grafting old trees the operator should have a good knowledge of prunings as it is not a very easy thing to entirely change the top of an old tree and get a good symmetrical top back again, but since no two trees can be treated in the same way it is impossible to give general rules that are applicable for all cases in a paper of this kind.

Grafting Wax.

The grafting wax used for covering the wounds in top-grafting is made by boiling together four parts, (by weight) of bees' wax, two parts resin, and one part tallow.

The amount of tallow is influenced somewhat by the climatic conditions, less being used in warm weather, and more in cold weather. The wax is applied while warm with a brush, or cloth tied on a stick, and on large wounds will likely have to be replaced once or twice before the wound is entirely healed.

THEORY OF PRUNING.

By R. W. Fisher of the Montana Experiment Station.

Pruning, in common with all other farm operations, has its basis in a theory, and before any one cuts a twig or a limb from a tree, I hold that he should know the result it will have upon the subsequent growth and life of the tree, both as to its form and fruit bearing capacities. Indiscriminate cutting and slashing often produces more harm than good, and such pruning, if it may be called by that name, has lead many to believe that pruning on the whole is harmful, or at least useless.

However, it may be seen from the examples of many trees and shrubs, that nature, if left alone, will prune; although it is generally a slow process, and can always be assisted materially by man, if done in a legitimate manner. One has only to look at the forest floor, covered with dead twigs, or to observe the knots starting from the center of logs and extending for only a short distance towards the outside, showing, that for some cause, the original limb has been crowded out, to realize how severely, in fact, nature treats her own plants.

From these illustrations it is seen that there is a severe struggle for existence among the different parts of a tree, there being many more buds and attempts at branching than there are branches. The stronger members inevitably crowding out the weaker ones; and since this difference arises some of the branches must die; that is, the tree will prune itself if left alone; and it is the work of the skillful orchardist to assist nature in her own

work, selecting the strongest buds and branches, and those best adapted, on account of their position to make the strongest limbs and produce the most fruit.

The whole theory of pruning is based on the general plan of plant life, and more particularly on the development of fruit spurs and fruit buds.

For fruit production is the ultimate object every orchardist has in mind, and all pruning should be such that the greatest amount of good fruit can be secured from the tree during its life. And in these days of keen competition the very best quality of any one variety is the one that will find the quickest market, and command the highest price. And if the orchardist thoroughly understood the methods by which the fruit spurs and buds are borne, it seems as if much of the mystery surrounding pruning could be cleared up.

Apples, pears, plums and cherries are borne on short, stubby branches, developed on wood at least two years old, and continue fruitful for a period, determined by the variety, and by local environments.

The apple spur grows zig-zag, on account of the new bud developing, not at the apex, as in most fruits, but on the side of the spur, and is fruitful for a period of three or four years, when it dies or bears only inferior fruit. Thus we see one reason why it is necessary to prune out the old spurs, and induce new ones to grow. And since all the fruit spurs cannot produce fruit, and at the same time form a new fruit bud for the ensuing year, we have the alternate bearing apple trees; and here the work of the operator is to so maintain the balance between the wood growth and fruit production that he may have fruit buds each year. And if we are to have an annual crop it is evident that the trees should be handled in about the same manner each year. That is, there should be some systematic pruning done in the orchard every season. It may be not more than the cutting out of the dead twigs, or removing wayward or cross limbs, yet it should be done at the proper time, as all such wood is a detriment to the fruitfulness of the trees.

We have seen that the fruit spurs on the apple are productive for only a few years, and hence new production of wood is essential, and all pruning should be to this end; while in the plums, cherries and pears the fruit spurs are productive for quite a number of years, and when the trees have once attained their size,

and have the desired shape, little or no pruning is necessary.

Raspberries and blackberries bear fruit on the wood of the current year's growth, which having once borne fruit, dies, with the stock on which it has grown, and new shoots start from the roots. The necessary pruning in this case is quite apparent—to remove the dead shoots, and possibly thin out the growing ones.

Currants and gooseberries bear their fruit similarly to the apple, and like the apple, require new wood every two or three years.

Why We Prune Young Trees When Transplanting.

As the tree grows in the nursery row, the top and root system is perfectly balanced—under normal conditions the roots supplying just enough moisture and nourishment to keep the top in a flourishing condition, and whenever a tree is dug, no matter how carefully the operation is done, there is bound to be some of the roots lost; thus breaking the balance of root and top. Now if the tree were to be planted in this condition, without cutting back the top, there would be more evaporating surface than the impaired roots could supply. The top, (through its leaves), and the roots are mutually dependent upon each other for their growth and this cutting off of part of the root system, without decreasing the top in a proportionate measure, will give to the top a very feeble growth; and since the roots are dependent to a certain extent upon the vigor of the top, they also will suffer.

The amount of such pruning of the top varies much with the time of planting, climatic conditions, and the shape that is desired in the tree, as this is the formative period in the tree's life, and a great deal of its future usefulness depends on the way in which it is started.

Shaping the Head.

Next to securing the right variety, and probably of greater importance, is the subject of shaping the head, for on this depends, in a very great degree, the future usefulness of the tree; and the great diversity of opinions in regard to this subject, indicates the truth that methods should be modified to suit different conditions.

Where the growing season is comparatively short and dry, followed by severe winters, the tendency is for the trees to come to maturity at an early age, and produce fruit at a time in their

lives when they ought to be making wood growth, and establishing a strong frame for its future fruiting.

Systematic heavy pruning of the top in winter or early spring will give under normal conditions of the tree, this required wood growth, and this is the method that suggests itself to me to be followed in this state. The height from the ground that the tree is headed, or started to branch, has been the subject for much discussion among horticulturists, and is dependent probably as much on the usual preferences of the grower, as on any other consideration. However, there are certain well defined advantages in favor of both high and low heads. A tree with a low head is more easily sprayed, the fruit is much more accessible, the strong winds cannot get such a purchase on it, and if a tree starts to branch, say at the ground up to 2½ or 3 feet from the ground, it is quite apparent that there is not so much danger of sun scald; and with the improved implements for cultivation now to be had, there is not much to be said in favor of the high-headed trees.

To be a little more specific in regard to the formation of the top, let us start with a tree two years old, as a tree of this age can be shaped to one's ideal easier than older ones. After being planted, we will cut this whip back to 20 or 24 inches above ground, and allow it to make its season's growth.

The following spring, this tree will have made five or ten branches, possibly more; and from these we are to select the ones, (cutting out all others) that are to be the foundation of the frame work. Take three or four of the strongest limbs, being careful that no crotches are formed, and that they are evenly distributed around the tree. These limbs should be cut off about one foot from the trunk, making the cut above a strong, plump bud. The third and succeeding years' pruning does not differ materially from the second, except that in the third year the limbs are selected that are to make the upright growth of the tree.

The aim should be a symmetrical, low, somewhat round head; not too full of wood and yet not too thin.

DISCUSSIOIN PAPER ON PRUNING BY R. W. FISHER.

C. W. H. Heideman. I think the paper we have just heard has enough merit in it to ask the press reporters here to give it more than passing notice. This subject is one that is at hap-

hazards in this valley. It has become mere murdering in some parts of the valley. Last spring I was in an orchard near Hamilton and this orchard showed that the owner's idea of pruning could be expressed by the word dehorning. He cut off the branches regardless of any plan, just so he made them a certain form was all that was necessary. Before you cut off a limb you should be sure the effect that is going to result. Nearly every fruit grower who came and saw the orchard said it had been ruined, but there are others who said it was not. The orchard bore a fine crop of apples last year but those who were up there and said the trees were injured will have their innings. The press said, that notwithstanding the criticism that the trees had been injured, that because they produced a fine crop of apples, last season the question of pruning was solved. Pruning should be a progressive science. Unfortunately there are only a few who realize that this applies to pruning. Dead wood and crotches should always be removed.

R. Parkhurst. I had some pruning done some years ago and the trees were cut back a good deal. I think it was well done. I think the trees received no injury. They have produced fine fruit.

C. W. H. Heideman. Were they as severely cut as those I mentioned?

R. Parkhurst. It was severe, but not as severe as those you spoke of. The stubs were waxed. I am in favor of cutting back the trees to a limited extent. In the case of the Wealthy I believe it is the only way to save your trees. My apple ground is very rich. The limbs come out very long and slender and need to be cut back to keep them from breaking. I tried to prop them and sometimes I succeeded and sometimes not. A tree should be pruned so as to be self-supporting at all times.

C. W. H. Heideman. In regard to waxing the stubs and scars I would like to hear from different people. I am a little skeptical about it.

A. Estey. I think it is necessary. I think white lead is the best, a little thicker than for regular paint. I observe that many, in cutting off limbs, use a saw and leave the stub rough. This is a mistake. Take a sharp knife and leave a smooth cut. Where a limb is cut off and not painted or waxed, it checks the growth and leaves a dead spur which is liable to injure the remainder of the limb where it is cut off. Where it is painted the scar heals up

very quickly. It seems to seal it up and make it grow better.

T. A. McLain. I do not know as I am an authority on the pruning question especially as to waxing or painting. I have practiced both and cut off large limbs without putting anything on them and they heal up just as quickly. Where you use wax it checks the flow of sap and keeps back the growth badly. If pruning is done in the right season nature will supply the need. The callous that forms over the end is better than anything you can use. In regard to severe pruning, I tried a few trees and satisfied myself that it is as Mr. Heideman says. It took a long time to establish another system of pruning. Prune the trees when they are young, and as nearly to the form you desire as you can. It is always hard to say just what a tree is going to do when it is pruned. In starting a growth perhaps the trees will have to be pruned severely to give them a close head. In general, I would discourage this severe pruning. It may produce a better quality of fruit the first season, but there are other ways that are better. There are few of us who have courage enough to go into an orchard and thin it out properly. I have tried it and find that I always leave too much there. It seems hard to cut it out but it has to be done. Take young trees and prune them when the limbs are small and you will have better results.

Q. What is the right season for pruning?

T. A. McClain. Right after the sap has begun to flow. I do not prune in freezing weather. I have injured more of my trees by cutting limbs off when it is freezing than in any other way, After the sap has begun to flow it prevents this.

D. E. Bandmann. What Mr. McClain has just stated is exactly the truth and Professor Bailey has said identically the same thing. The idea that pruning should be done in the winter is a mistaken idea. If you want to prune for fruit, prune when the sap is working. If you want wood, prune in the winter. Bailey says prune in the months of May and June and until the buds are open. As for myself I prune whenever I like.

C. W. H. Heideman. All the authorities in this country on the subject of pruning will agree that all wounds made by pruning should at once be covered with paint or grafting wax or any substance that is antiseptic and at the same time will adhere to the wound for the purpose of preventing moisture from entering into the heart-wood of the tree and preventing germ rot from entering. The germ cannot enter through a healthy tissue. A

wound of a tree requires considerable time to heal over, varying of course with the size and character of the wound. They also agree that during the time it is healing over the rot germ is liable to enter and it spreads from there to a healthy tissue. There is a great deal of complaint in this valley on account of short lived trees. The so-called black-hearted trees are trees that are entirely rotten at the heart and it is induced by lack of precaution with these wounds. A heavy load of fruit has caused branches to break off exposing that heart wood to the air and then they get infested or charged with rot germs and in that way have become diseased or rotten.

As to the time of pruning, the old theory that you can prune whenever your knife is sharp and that you ought to keep your knife sharp all the while, is a good one with limitations. It does not mean that you can prune every day in the year with a saw or an axe. Pruning ought to be progressively done. Remove large limbs or branches at any time. If the pruning is commenced at the right time and the tree properly balanced up, nature will almost do the rest. Experience has shown that there is but very little difference in the recuperative power of a tree in healing over a wound made any day in the year. In extreme cold weather there is danger of splitting or breaking the limbs in the operation of pruning, but otherwise there is no reason known why pruning should not be done at that time.

W. B. Harlan. In regard to the point of plastering over the wounds caused by pruning, I think there is a great deal of time and material wasted in doing it. I have noticed that on wounds in this climate on an ordinary stub, the scar heals over without rotting at all. It closes up quickly. We are told sometimes to put stuff on to keep the sap in, but experience has been that it is necessary only when a tree has been pruned when it was out of condition. I have noticed that on some occasions the painting of these scars had a bad effect. There is one orchard near Grantsdale where all the points were covered with white lead. Two months afterward there were spaces with no bark around the scar. The orchard was ruined by that, and by pruning when the orchard was frozen. I was told later that the owner was advised to cut off the points and stick potatoes on them which would keep them from drying up. That made it look more like a potato patch. I do not believe it is necessary to cover them, it is a waste of time and material.

C. W. H. Heideman. I want to take issue on that part with the chairman. The object as I understand it, in painting over the wounds, is to prevent the access of germs from the air. The rot germ cannot enter through a healthy tissue. I believe every limb over one-half inch in diameter ought to be covered with some antiseptic paint. I believe it is a good investment to paint every stub.

A. Estey. About the tenth of November a sleet occurred in Flathead county which did great damage to our orchards. Two parties were strong advocates of cutting limbs off, of severe pruning. Those two orchards suffered the greatest damages. There was not a limb on any of those trees that was painted. Two-thirds of these trees were utterly ruined. In one orchard $1,000 worth of damage was done. For that reason and others I am a strong advocate of trimming a tree and painting it. Cut out all of the crotches and always have the leader strong.

R. W. Fisher. In regard to the wound, I think it depends largely on the nature of it and the condition in which the tree is. If you make a wound on a tree when the sap is not flowing very fast that wound will tend to check and as soon as the cambium becomes dry the wound cannot heal. If you cover the wound so that it will not check and the cambium become dry, it will naturally follow that it would be helpful in healing the wound. If it is small no covering is necessary, but if it is one inch in diameter or larger the wound is liable to check in the early stages and the covering is necessary.

R. A. Cooley. Does painting ever kill the cambium?

R. W. Fisher. I have never heard of an instance of it. Coal tar has often been found injurious, but linseed paint has never been found to be injurious.

W. B. Harlan. There are many specimens in the Missoula valley where large wounds have healed over without being painted but we all know of instances where healing has taken place without any protection. This would be no proof.

R. W. Fisher. When healing has once started it will go on. Covering will not make it heal any faster.

B. K. Beeschove. In the Ambrose orchard some limbs were cut that were as large as my wrist and I watched the result. No pruning was ever better. The trees were about four years old. This is the only knowledge I have of pruning without painting. The trees are trimmed in September.

D. E. Bandmann. I have read that if there is a hole in a tree that you can cut away the bark and fill the hole with chips of wood, and if you can cut them flat enough and thin enough and put wax on, the tree will shap itself so as to cover over the hole.

W. B. Harlan. What is meant by a crotch?

C. W. H. Heideman. When the branches go out at almost right angles. The Alexander is an example of a tree that does not form crotches. The Northwest Greening does. With the McIntosh you will find it liable to separate and form into heads that will have crotches in them. If you remove one part of the crotch you certainly strengthen up the rest of the tree. I insist that covering up the wound is not as necessary in this country as in others. The climate hastens the healing somewhat but I claim that it is a profitable investment to paint all limbs over one-half inch in diameter.

R. A. Cooley. It has occurred to me that it ought to be a profitable thing to thin fruit. I want to mention that in the states to the west of us they are beginning to feel that the codling moth is a good agent in thinning out fruit. That impression is getting abroad there and I want to discuss it for a moment. There are two broods of the codling moth in this vicinity in a season. The first one comes out when the fruit is quite young and the second when the fruit is more mature. The codling moth may be beneficial to the early fruit in thinning it out, but it does not stop there. The fruit is half grown when the second brood comes out and the moth is then an injury. The harm very much overbalances the good that is attained.

M. H. Pierce. Does the moth promise to be plentiful enough in this vallew to be of use in thinning the fruit?

R. A. Cooley. It has been shown that it is capable of destroying 50 per cent in orchards. At Helena it destroyed 95 per cent. It not only does good work in thinning but goes on and takes the profits.

D. E. Bandmann. I would like to know what is the best way to thin fruit.

W. E. Bass. I find it necessary to thin every year especially the Wealthy trees. It has small limbs and gets over-loaded. I cut off the ends of the limbs. The result is very much better than thinning the fruit out of the trees. If you want fine specimens go to a tree loaded with fruit. Every year I try to cut off a few limbs from the trees.

D. E. Bandmann. What size limbs do you cut?

W. E. Bass. Branches as large as walnuts. Cut the limb off far enough back so that you know it will support itself. Some trees do not need it. The Wealthy, the Northwest Greening and the Duchess break down badly even if they are thinned or propped up.

D. E. Bandmann. How do you thin the top of the tall trees?

W. E. Bass. We never grow trees very high. It is not the high limbs that get over-loaded. It is only the low branches. It is better to cut off the limbs than to pick off the fruit. You save the tree from breaking down.

A. Estey. In speaking about thinning the Wealthy there is this: the Wealthy apple forms in bunches and at the end of the limb. There has been considerable talk about the Wealthy falling too much and I have observed that there is a way to prevent it. If a person would thin his fruit it would be alright. One apple in falling knocks off a dozen or more if it happens to strike a bunch. The method Mr. Bass proposes will not remove the difficulty. If a person will thin out bunches and leave only a few in a cluster they will not crowd themselves off and fall so badly. The bunches that grow closest to the end of the branch should be thinned the most.

C. W. H. Heideman. I experimented on thinning on a large scale last year. I have found as a rule that an owner is not liable to thin enough. I have never been able to hire a man to thin as much as I told him. When I thinned as much as I thought ought to be done I was satisfied that I had injured the size of the fruit to some extent, yet it did not fall as badly as it had done. The theory of it is alright although the results are not as good as we might expect.

C. C. Willis. My experience is that whenever I cut a limb off in the summer time it sends out sprouts along what is left and then you have to cut these off. I find that the more you prune in summer, the more sprouts you have.

W. E. Bass. I have never noticed anything of the kind.

W. M. Wooldridge. Did you ever try tying up a tree or wrapping from one limb to another?

W. E. Bass. I have seen that done but when a tree is loaded the limbs will break. I always prop them up.

Q. How will apples stand shipping in cold weather?

D. E. Bandmann. Frost does not hurt an apple until it gets

very close to freezing, 5, 6 or 7 degrees above freezing is alright. The Northern Pacific Railroad Co. will ship apples in refrigerator cars as long as climatic conditions are standing 32 degrees or running 10 below. It is supposed that apples are kept about 10 to 20 degrees above freezing in a root house.

M. H .Peirce. I do not believe it is safe to leave a cellar open when the temperature is as low as 15 to 20 degrees above zero. I claim that an apple that will not keep later than January is a poor apple. There are plenty of varieties here that will keep until January and be good eating.

SOME OF MONTANA'S MOST IMPORTANT INSECT PESTS.

By R. A. Cooley, Entomologist, Montana Agricultural College.

Surely the codling moth should be included in a list of Montana's most important insect pests, but since this insect has been so often and so fully discussed we will on this occasion, refrain from mentioning it, other than to state that it is still the prime apple pest of Montana, and one that the Montana fruit grower will do well to protect himself against.

The Apple Leaf Aphis.

Three species or plant lice of first class importance occur on the apple in the United States. They are the following. The apple leaf aphis (Aphis pomi De G.), Fitch's apple aphis (Aphis fitchii Sanderson), and the rosy apple aphis (Aphis sorbi Kalt.) In the Country at large Fitch's apple aphis is probably the most common and widely known of the three species, yet in Montana the apple leaf aphis is very much more abundant and better known than the other two. Our experience up to this time indicates that the last named species is almost entirely responsible for the injuries that Montana's apple trees suffer from insects of this class.

If an orchard or nursery affected by this insect be closely examined during the winter months the small, glossy black eggs of this insect may be found secreted in the cracks and crevices

of the bark and at the bases of the buds. When present in great numbers, as they often are, they may be found at any point on the bark, no attempt having been made to conceal them. Very early in the spring, even before an of the buds have opened, they begin to hatch into very minute and awkward lice which may be found crawling over the bark. Some hatch too early for their own good, and are destroyed by cold storms. The writer has often observed that a very large proportion of the eggs never hatch but shrink and collapse early in the winter.

The young lice soon settle upon the buds and tender expanding leaves and begin feeding by sucking out the juices through their beaks. As soon as the buds have burst, the lice crawl down among the young leaves and being thus protected it is doubtful if even the most thorough spraying will completely destroy them. Those that settle upon the unexpanded buds can be killed but many do not arrive until the buds are opening and can protect themselves by crawling into the partly open buds. Later in the season, when the lice have curled the leaves, it is equally difficult to make good use of a spray.

The young that hatch from the eggs become the so-called "stem-mothers," which give birth to their young as do each of the successive generations that follow. In the fall of the year a generation of males and females is produced, and from this generation the winter eggs are produced. A part of certain of the generations become winged and migrate to other apple trees where they produce new colonies. A single winged louse is enough to start a colony since she can produce young without a male.

Comparatively few of the lice are to be found on the young buds or newly expanded foliage, but these multiply so rapidly that a large number is present later in the season, and on badly affected trees the leaves, particularly on the ends of the branches, become badly curled. Such badly affected branches often retain the dead leaves through the winter. Practical orchardists have also reported that such branches are much more susceptible to winter killing.

Throughout the United States there has been a wide difference of opinion as to the amount of real injury that is accomplished by these aphids. Without doubt, this difference of opinion is in part due to the fact that more than one aphis is commonly found on the apple and that the different species are not equally

destructive. It may be true, and doubtless is, that some species in some parts of the country are not very injurious, but it is certainly a fact that the apple leaf aphis is doing great injury in Montana. It may be that the climatic conditions of this arid state have an influence upon its power of multiplication and hence in its injuriousness.

The insect is more severe on young trees and often prevents them from making satisfactory new growths. So serious have its injuries been that in some sections of the state there has been a very noticeable slackening of enthusiasm. Growers have reported that their trees have been "paralyzed" and that "the apple aphis has threatened to annihilate the orchard business."

Realizing the seriousness of the situation, and being aware also that the remedies commonly in use are unsatisfactory, the Experiment Station has undertaken to secure a remedy that is more reliable. The work is not yet completed but we can report progress.

The remedy that has been most commonly used for this insect in Montana is a solution of whale-oil soap in the strength of one pound to six to eight gallons of water. Many have added quassia chips also. The liquid has been applied as a spray or the affected branches have been dipped. The remedy has not given goot satisfaction since the lice, protected as they are in the curled leaves, are not reached by the spray.

During the summer of 1902 the Experiment Station made a series of tests of the effects of the poisonous potassium cyanide gas on this aphis and also on the foliage of the apple. To summarize theresults it may be said that the gas liberated—one-tenth gram per cubic foot of enclosed space, and all strengths above this, killed every aphis without fail. Moreover, no injury to the foliage resulted even when the cyanide was used in considerably greater strengths than was necessary to kill the aphis. The fumigation was done during the daylight hours and on both bright and cloudy days.

The detailed results of these experiments, together with a description of the box employed to confine the gas around the trees, will appear in a bulletin from the Experiment Station.

In the eastern part of the United States it has been found that kerosene emulsion applied as a winter wash or spray is effective,

in killing the eggs. This has not, so far as we are informed, been tried in Montana.

The San Jose Scale.

In our zeal to protect the orchards of Montana from the dreaded codling moth we should not allow ourselves to forget the importance of being continually on the lookout for the San Jose scale. Through the work of our board of horticulture and similar officers in the states from which our trees are secured, we have thus far been protected from this dreaded insect. At least we have been unable to detect its presence in a single instance in Montana. However, we are constantly in danger from this insect and every fruit grower should carefully watch each lot of trees that he adds to his orchard to see if any of these insects appear. If present in a new lot of trees they should be easily detected during the first or second summer.

On apple trees the scales should be looked for on the bark and they may appear on any part of the tree. In cases of slight infestation the isolated scales only will be found, but in cases of longer standing the bark may be entirely covered and will appear as if thickly dusted with ashes. When crushed the crust produces a thick yellowish oily liquid which comes from the breaking of the bodies of the insects under the scales.

This insect is known as a scale insect from the fact that the body is covered with a dome-shaped scale. This scale is composed in part of the cast-off skins of the body and in part of a substance secreted by the insect. This scale very effectively protects the insect. The oyster-shell bark louse is also a scale insect and possesses a similar protective covering.

There is another scale insect in Montana which is a close relative of this species. This scale is fairly common in the western part of the state. It so closely resembles the San Jose scale as to be easily mistaken for it.

The fruit grower who finds anything on his trees which he suspects of being this insect should at once send specimens to somebody capable of deciding upon what the affectation is. The Experiment Station is always willing to answer such letters.

The San Jose scale is a difficult insect to control and when once fairly established in an orchard it is next to impossible to eradicate it. Besides attacking practically all kinds of fruit trees, it also thrives on many other deciduous trees and often escapes into

the surrounding woodland, thus making it a perpetual menace. In Montana it would probably take readily to alder, willow and cottonwood.

It is impossible to say to what extent this scale insect would be injurious in Montana's climate. It is certain, however, that it is highly undesirable to have it within our borders.

A discussion of the habits of this insect and the remedies to be employed against it would be out of place in this paper. It may be said, however, that by a timely and persistent use of known remedies the insect may be brought under control.

The Bud Moth.

This important insect was found by the writer in one of the old orchards on Front street in Missoula, May 21, 1902. A search through the orchards of the town showed that it was not confined to the one orchard where it was discovered, but was widely distributed. Serious injury has been done to a few trees and it was abundant on many other trees.

The presence of the insect is generally more easily detected during the spring of the year when the newly expanded leaves, being fastened together by the larvae, present an unusual appearance.

Being often in Missoula during the summer of 1902, opportunity was afforded for the study of this insect, and a fairly complete record of its life history was secured.

It is a well-known fact that the insects pass the winter in small cocoons constructed for the purpose on the branches of the trees. We have also found them among the cocoons of the codling moth, and under the scales of bark, on the trunks of the trees.

The larvae leave their winter quarters in the spring of the year and go to the buds, some arriving there before the buds are open, and, boring into the center, feed on the tender parts within. Others do not arrive until the leaves have begun to expand and, crawling into the crevices, these larvae proceed to fasten the leaves together, thereby making a sort of nest. The flower buds are also similarly affected.

Working as they do on the opening buds, these insects are capable of doing great injury. The fruit crop is literally "nipped in the bud."

The larvae continue to feed in the nests until about the middle of June, when they begin to transform to pupae, and from pupae to moths. On July 10, I was able to find only one pupae that

had not emerged. The moths lay their eggs on the leaves and the young larvae hatching from them feed on the epidermis of the leaves, often fastening two leaves together and feeding on the epidermis of both. The larva soon constructs a tubular case about itself and from this retreat ventures out for food.

On the approach of winter the larvae leave the foliage and go to the twigs, where they construct minute temporary cocoons to be occupied during the months of dormant life. These cocoons are remarkably hard to find so closely do they resembel the bark and so easily are they mistaken for the irregularities in the surface of the bark.

The insect is reputed to be a difficult one to control. Early spraying with arsenical poisoning is not very effective. The insect is often particularly severe on nursery stock and young orachards, and in such cases it may be controlled by hand picking of the nests during the months of May after the buds are fully expanded and the nests have become easily visible.

The State at large is not yet called upon to fight this insect and before it is we hope that remedies will be devised. The habits of the insect indicate a possible means of control which we hope to be able to test during the coming season.

The Pitchy-Legged Strawberry Weevil.

This is not a well-known insect though it occurs throughout the United States. Experience up to this time seems to indicate that its presence in a locality is not necessarily a serious matter. The insect collections at the Experiment Station show that it is widely distributed throughout Montana, but our attention is called only to one locality where serious injury has been caused by it. This locality is a few miles up the valley of the Rattlesnake creek. In this locality the beetle has been very destructive to strawberry plants, having almost completely destroyed certain large fields.

The very dark brown or nearly black beetles may be found in great numbers in the fall or spring of the year under clods of earth or in other similarly protected places. They often enter houses in great numbers and become troublesome, not from any injury they do but merely because of their presence.

The writer accidently found another thriving colony in the valley of the Bitter Root river, about seven miles from Missoula. No strawberries were to be found in the vicinity yet quantities of the insects were in hibernation under stones, boards, etc.

This beetle is probably a native species and doubtles feeds on some unknown wild plant. If an attempt should be made to start the strawberries in the vicinity of the old mill site between Lo Lo and Missoula, which is the spot above referred to, the beetles would certainly be troublesome.

Besides being present in the strawberry fields of the Rattlesnake valley the beetle also occurs to some extent in the garden patches of strawberries on both sides of the river at Missoula.

Fortunately for the growers of strawberries the insect is not able to fly and is therefore limited to accidental means of spreading. It is not probable that they cover much distance by walking but they can easily be transferred from place to place among plants intended for stocking new fields and they are also distributed in irrigation ditches. The last mentioned way is probably the most important one. At the present time it is impossible to state how much importance should be attached to the matter of the spread of the insect since, as we have already stated, it is probably a native species. If its occurance in the state is confined to restricted localities and if a few specimens introduced into a field are capable of multiplying to injurious numbers, it is important to prevent its spread as far as possible.

Our knowledge of the life history of this insect is still imperfect. During the summer of 1902, we bred the insect in cages at Bozeman and obtained some valuable information, yet certain facts remain unsettled. The beetles pass the winter in the adult stage and, appearing in the spring, do a considerable amount of injury by eating the leaves of the plants. They burrow to a considerable distance into the soil around the plant and their small yellowish white eggs may be found scattered through the soil and fastened to the leaves and stem. The period of egg-laying is long and, as a result, all stages of the insect may be found during a considerable part of the summer. The larger part of the insects reach the adult stage in the fall, but it is probable that a few remain as larvae or pupae during the winter. The small, white grubs which hatch from the eggs at once begin to feed on the rootlets and as they increase in size they may be found on any part of the roots or crown. The surface of the roots eaten off and the crown becomes riddled. The full-grown larvae or grub is whitish, slightly hairy, and the curved body nearly ¼-inch long when extended. The pupa is about the same size as the larvae but show the appendages of the adult

plainly indicated. At first it is whitish but with age it turns brown. No satisfactory remedy for the insect is yet known.

DISCUSSION.

H. A. Briggs. I would like to ask if the black ant has anything to do with the apple aphis.

R. A. Cooley. It is a well known fact that ants do all manner of strange things and they take eggs and store them over winter. When the aphis gets out of pasture the ants carry them to a more suitable place. I have never seen this done but it is known that it does occur. A great deal of work should be done before any definite statements are made about the relationship between ants and aphids in Montana. I should mention that there is an ant in this valley that gets into the soil about the trees and has even been injurious to the trees. Has this been a common experience in the valley?

R. W. Nichol. It has been so with me.

R. A. Cooley. Try Carbon-bi-sulphide.

R. W. Nichol. I have tried coal oil but it does not work very well.

R. A. Cooley. Carbon-bi-sulphide has a heavy vapor which follows the holes in the earth. It not only kills the workers but the mothers of the colony as well. One or two fluid ounces placed in a colony should be sufficient.

R. W. Nichol. Have you ever found that extreme cold weather destroys the eggs of the aphis?

R. A. Cooley. At least 95 per cent of the eggs in Montana die from some cause during the winter but enough survive to bring the number up to its usual status.

R. W. Nichol. My orchard was badly infested until three years ago when we had extremely cold weather and since then it has not been infested.

R. A. Cooley. If I were you I would not depend upon anything but a microscopic examination by an expert. Sometimes it may be determined with a hand glass lens if one is very familiar with it.

W. B. Harlan. I would like to mention that I have had lots of apples injured two different years by ants direct. A very large ant was found upon some half-dozen trees in question. They were all over the limbs and when the trees were in bloom they cut out all the stamens and pistils during those two years.

R. A. Cooley. I have never heard any such statement and it is very interesting to me. I have, however, known of one case where the buds of the tree were completely destroyed by a colony of ants nearby.

Q. Will spraying kill the codling moth?

R. A. Cooley. Yes, spraying with arsenical poisons such as Paris gren, arsenate of lead or arsenite of lime, is the most effective and about the only practical remedy for the codling moth, in large orchards. By the use of such sprays, large orchardists are now able to prevent all but a small percentage of the loss from this insect. Such successful spraying, however, is always very thoroughly done and is based on a knowledge of the habits of the pest.

Q. How can I tell whether or not I have the codling moth in my orchard, that is, before it has become injurious?

R. A. Cooley. By watching for wormy windfalls, particularly of summer varieties and by watching for wormy apples in the harvested fruit.

Q. My house is in the corner of my large orchard. If I have the codling moth in my orchard will I not find some around the lights at the house?

R. A. Cooley. No, the codling moth does not fly to lights as many other moths do. Under such circumstances as yours we may find moths at the lights but they will not be the codling moth.

Q. Will the codling moth ever be destructive in Montana? Is not our climate too cold?

R. A. Cooley. My experience in the state for the past four years has led me to believe that wherever we can successfully grow apples in Montana the codling moth will be more or less injurious. Some sections will suffer more injury than other. The immediate vicinity of Flathead Lake and the Yellowstone valley will be the parts of the state that will suffer the heaviest loss if the pest gains a foothold. These localities have warmer nights, more suited to the needs of the moths in depositing their eggs. It is a matter of common experience in the United States that this insect is much more injurious some years than others. In Montana we may expect that, left to itself, it will take 20 to 50 per cent of the fruit.

Q. How should I treat for apple aphis?

R. A. Cooley. In the first place do not allow the lice to over-

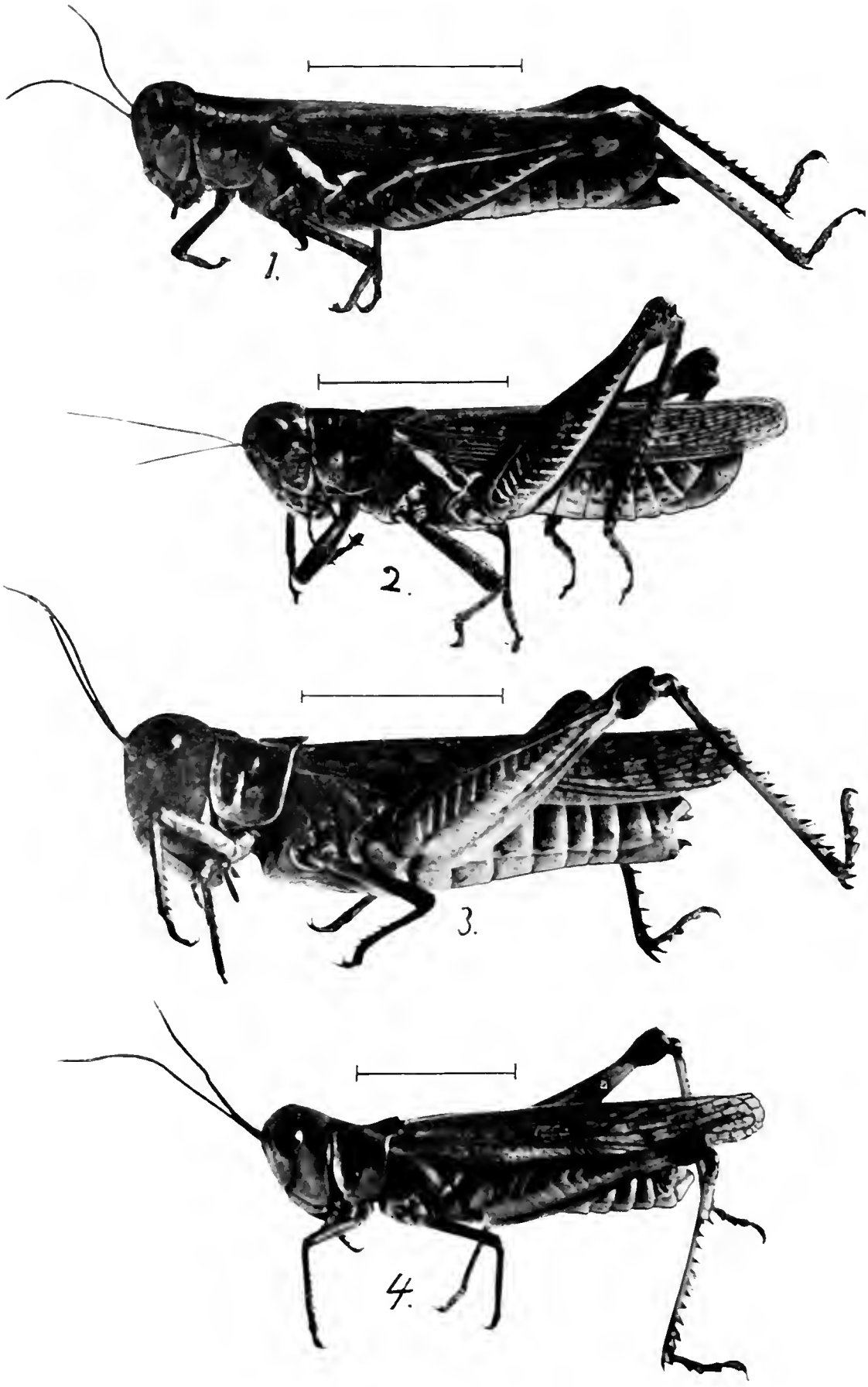
run your orchard before beginning to fight them. They multiply very rapidly and it is best to treat for them early in the season, before they have produced migratory forms. When confined to the tips of the twigs on small trees send a man through the orchard, up and down the rows, dipping the affected twigs into a pail of whale-oil soap solution (one pound to 5 to 7 gallons of water) or kerosene emulsion (one part to 10 or 12 of water). The presence of the insects on the leaves soon caused them to curl. Spraying therefore is not usually very effective since it does not reach the bodies of the lice. It is said that spraying or washing with strong kerosene emulsion in the winter will kill the eggs of the insect and so prevent necessity for summer treatment.

Q. How can I kill the ants on my lawn?

R. A .Cooley. First locate the home of the ants and then pour into each opening a small quantity, say two table-spoonfuls of carbon-bi-sulphide. The fumes of this liquid are heavier than air and they settle into the passage-ways in the lower part of the nest and wherever they come in contact with the ants they kill them. The fumes are very inflamable and slightly explosive. By throwing a lighted match onto or into the opening the fumes ignite and by successive explosions drive the fumes to the remotest tunnels. The mothers of the colony are in the lower part of the nests and are not usually seen above the ground. Therefore little good is done by killing now and then one, or even a great many, on the walks or in the house. In order to be rid of the ants it is necessary to kill the mothers. Carbon-bi-sulphide can be obtained from any druggist.

Q. Will aphis kill apples trees?

R. A. Cooley. I do not recall a case of death to an apple tree from aphis. However, it often occurs that the lice become so abundant as to seriously injure the trees. Young trees in the orchard row are more often injured than old trees.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GRASSHOPPERS IN MONTANA.

By R. A. Cooley, Entomologist Montana Experiment Station.

The last two or three years have been notable in some parts of Montana on account of the unusual abundance of grasshoppers. During the same period there has been also an unusually small amount of snow and rain in the same parts of the state. These two conditions have caused a considerable damage to agricultural interests on both the fenced and open ranges where many thousands of cattle, sheep and horses are grazed and in the irrigated valleys where alfalfa. grains and grasses are produced in enormous quantities.

The region principally affected may be roughly defined by stating that it embraces that part of Montana drained by the Yellowstone river, between Miles City and Big Timber, including not only the valleys of the Yelowstone and its tributaries that come in from the south but also the cross-country between the tributaries. Not all of this territory is seriously affected, some parts, in fact, being wholly uninjured. On the other hand certain more or less restricted areas were so affected as to leave practically nothing for the stock. For the most part the irrigated crops were not badly injured except in localities where the grasshoppers had become so abundant that practically all of the native grasses on the hillsides had been taken. Exception to this must be made, however, for the localities in which the two-striped locust occurred. This grasshopper, shown at Plate II, figs. 3 and 4, is considerably larger than the other destructive species considered in this paper and is found only sparingly on the dry hillsides but seems to prefer the more succulent vegetation of the lowlands. This species is the one that caused the greater part of the injury of the alfalfa meadows.

Beside the territary above outlined we received complaints also from various other parts of the state. Some damage was done on the range in Madison county, and one report of injury came in through Townsend from the country northeast of that town and we received one complaint from near Plains, Missoula

county. The same species of grasshoppers were abundant in all of these localities, and were found by the writer on the divide between Bozeman and Livingston and on the hillsides and slopes in the Paradise valley leading from the town of Livingston toward the Yellowstone Park. They were so abundant in these localities that had it not been for the abundance of rain in this part of the state during the preceding winter and spring, their presence would have been seriously felt by the ranchers. They ate a great deal of grass but what they took was not as seriously felt as farther east, where, on account of less moisture, less grass grew.

No one species of grasshoppers is alone the cause of the devastation nor are the principal destroyers the same on the range as in the irrigated valleys. In entering the affected regions we found a strange medley of grasshopper life.

As they flew up before our feet we recognized many different kinds, of all sizes and colors, yet it was everywhere noticeable that on the range, two or three species, taken together constituted a very large percentage of the total number. The less abundant or secondary destroyers varied to some extent in different parts of the state but the three species shown in the accompanying illustrations, were found in every locality. These varied in relative abundance in different places and occasionally one or another was absent, but broadly considered these three were the principal destroyers. The are the 1. Big-headed Grasshopper; 2. the Lesser Migratory Locust, and 3, the Pellulid Locust. See Plate II, figs. 2 and 3, and Plate I, figs. 1, 2, 3 and 4.

In point of numbers the Big-headed grasshopper has been the leading species of the three. It feeds on grasses, is very active and seems to be at home on the dry sunnny slopes of the mountains. In crossing over the mountains between the Paradise or upper Yelowstone valley and the Trail Creek Valley, it was noticeable that this species, while very common at the base and on the lower slope faded out and disappeared on the top of the mountain, though various other species occurred over the entire mountain. This grasshopper may be recognized from the accompanying figures. Viewed from above, the head is wider than the thorax while viewed from the side it appears unusually large for the other parts of the body. The male is distinctly smaller than the female and has the antennae longer than in the

female. The tibiae of the hind legs are blue, the knees black and the feet yellow.

The lesser migratory locust stands second in importance. The appearance of the insect is well shown in the accompanying photograph (Plate I, Figs. 1 and 2.) The tibiae are usually red. This grasshopper is well known in the United States on account of its destructiveness, and is interesting on account of its resemblance to the Rocky Mountain Migratory Locust. It prefers the drier uplands to the agricultural valleys but in some cases was very abundant in grain fields. This species is capable of rising on its wings into the air and flying off.

The pellucid locust is more local in its distribution, often occurring in immnese numbers in restricted localities. The yellow under wings, the spotted upper wings and the yellow tibiate are noticeable characters of the species. (See Plate II, Figs. 1 and 2). This grasshopper is also capable of migrating.

We have briefly referred to the two-striped locust as an injurious species. This insect is very common in Montana and is well known over a large part of the United States. The longitudinally striped femur, and the two converging stripes on the back are conspicuous characters. The tibiae are blue-black, paler toward the feet.

The four injurious species here considered all have practically the same life-history. The winter is spent in the egg stage in pods in the ground. The individual eggs are one-fourth of an inch, or a little less in length, yellowish, whitish or brownish in color and surrounded and protected by a secretion from the parent insect that is at first frothy but later turns to a spongy mass. There may be from 15 to 20 up to 70 or 80 eggs in a single pod. With the aid of special organs for the purpose the female sinks holes into the ground to the depth of about an inch. The eggs are deposited in the bottom of this hole with more or less regularity. The frothy mass of gluey substance is an admirable protection against cold and water, yet does not prevent the exit of the delicate young grasshoppers when they hatch. Most of the eggs are deposited during the latter part of the summer and in the early fall but some species continue depositing until late in the fall when cold weather kills them off. It has been stated by many writers that the females prefer such open places as roadsides, banks of ditches, edges of fields, etc., for depositing the eggs. It was noticed, however, that the Big-

headed locust paid little heed to placing the eggs but put them over the entire hill-sides.

With the return of vegetation in the spring the young grasshoppers hatch and emerge from the egg pods and begin eating. When young they prefer to remain in the neighborhod of brush and low growing plants and when disturbed hop under the plants for shelter. As they get older they go out and become distributed through the fields. In cultivated crops they show a marked tendency to remain around the edges of the fields.

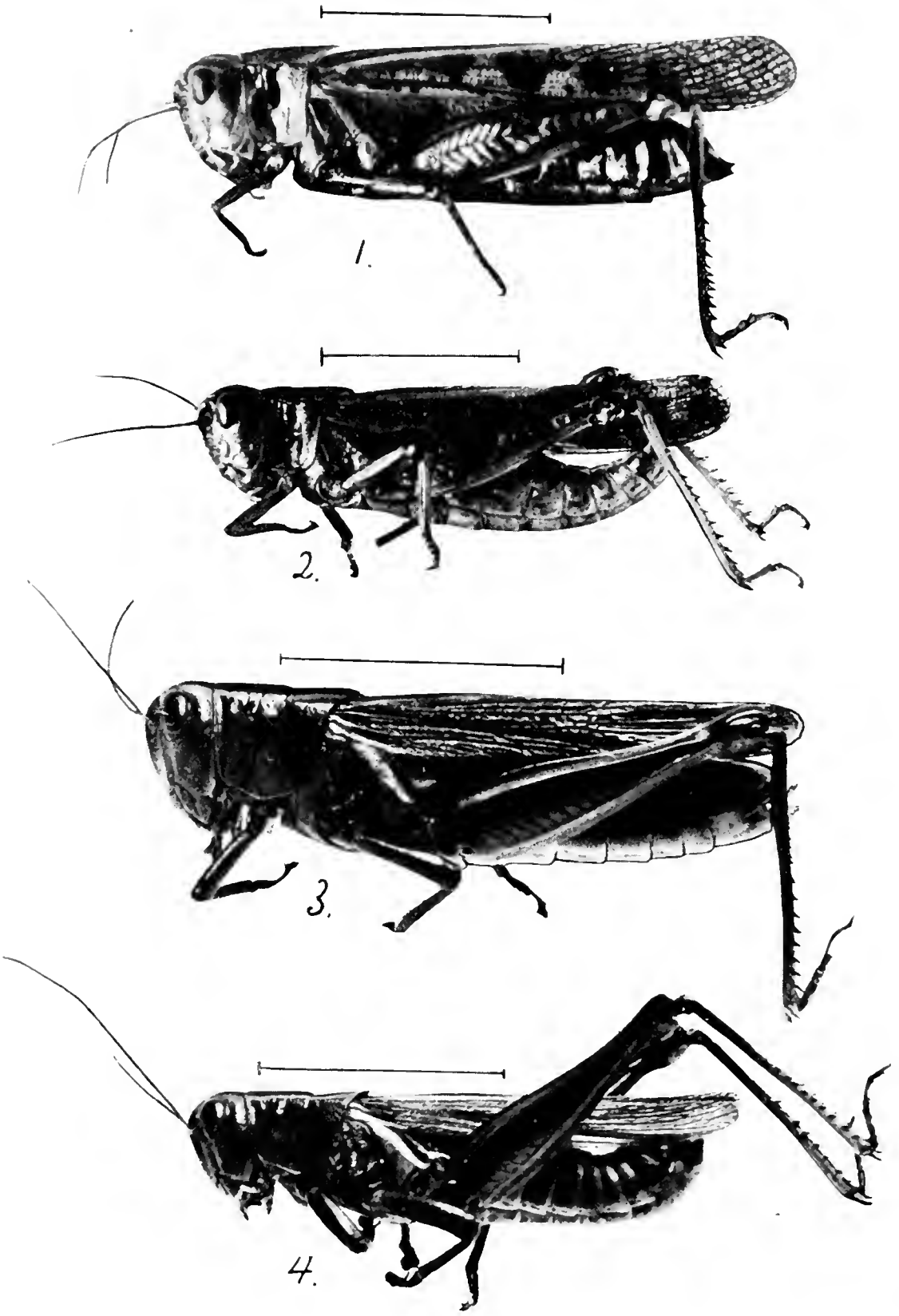
Remedies.

In the protection of cultivated crops against the inroads of grasshoppers we have the advantage of the accumulated experience of many years in the agricultural states to the east of us. Many remedies that have been propesd have been found to be worthless while experience has shown others to be very effective. In this discussion we will mention only those of the most value.

Deep plowing late in the fall or early in the spring is the best of all artificial remedies where it can be employed.

This practice is aimed to kill the eggs or prevent the young from reach the surface of the ground if the eggs are not killed. In this manner also the young grasshoppers if they are not too large may be turned under and destroyed. A thorough harrowing, especially with a disc harrow, is effective in destroying the eggs either by crushing them or by exposing them to the weather and birds or other natural enemies. Whether plowing or harrowing will be employed by the Montana farmers must be decided by the property holders themselves. It is doubtful if this means will be feasible in many cases under Montana's conditions.

Another favorite means of protection is poisoning the young hoppers with various preparations of arsenic. Any of the arsenic poisons may be used, such a Paris gren, arsenite of lime, arsenate of lead, etc. They may be sprayed on vegetation on waste lands where this may be done without danger of injury to stock or they may be applied to various materials used as bait. Arsenic bran mash may be prepared by mixing one pound of Paris green with twenty pounds of bran and adding enough water to cause the particles to adhere together in a crumbling mass. This may then be sown broadcast where the hoppers are most abundant. Another material known as the Criddle mixture has lately come into favor in some parts of the United States. Dr. Fletcher,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Government Entomolegist of Canada, first called public attention to this form of poisoned bait at the meting of official entomologists at Washington, D. C. 1903. It is made as follows: Take 1 part of Paris green, 2 parts salt and 40 parts of horse manure, by measure. Add sufficient water to make it soft without being fluid. Scatter it through the field to be protected in quantity proportioned by the number of hoppers. This is a very popular remedy in Canada and Dr. Fletcher has said that it has entirely replaced the cumbersome and inadequate hopper-dozer. Practical experience in Canada and experiments by Profesor Washburn in Minnesota have indicated strongly that there is no danger of injury to fowls that go into fields that have ben treated with this bait.

Hopper-dozers will be mentioned only briefly here. They are sheet-iron pans of varying styles and sizes, 3 or 4 inches in depth. Kerosene oil or oil and water are placed in the pans and the pans are drawn over the field by a horse or by men or boys. The grass- hoppers when scared from the earth hop into the pan and having once been touched by the oil they are sure to die. A vertical expension of cloth at the back of the pan prevents the insects from hopping over the pan.

There can be little doubt that while these pans have been of great service in the past in killing grasshoppers, their day is over. In all cases where they can be used effectively the Criddle mixture can be used with equal effect and at much less expense.

By covring the restricted localities where the young are hatching with straw and then putting fire to the straw much good may sometimse be done.

The remedies above discussed are aplicable only under the conditions that exist in the agricultural fields, not on the range. On the range the problem is a different and a vexing one. The profit per acre from grazinz is so small that little or no outlay in fighting them is warrantable. It is here particularly, then, that the idea of the use of a disease is most attractive. If we could innoculate a few grasshoppers with a deadly disease and set them free in the field thereby allowing them to mix with their fellow and communicate the disease to them we would have an almost perfect remedy.

Since this form of treatment offered the only hope of relief from the grasshoppers on the range, thorough tests were made during the summer of 1903. A culture tube of the South African

fungus disease was secured from Prof. C. P. Gillette of Ft. Collins, Colorado and many tubes prepared from it were sent out to different part of the state together with directions for its use.

So far as we have been able to learn, absolutely no good was done in this way. The disease failed to take effect.

Various other entomologists in the United States have also been experimenting with this and other diseases but all have had the same experience as the writer. It seems plain therefore that until something entirely new in the form of a disease is known we will still have to wait for nature to take her course except where it is feasible to use poisoned baits or plow in the eggs and young.

Since we do not know the cause of the unusual numbers of the grasshopper in Montana we cannot predict when relief will come or what agencies will bring about the relief. It may be that absence of the usual number of natural enemies is the direct cause of the outbreak. If this be true it would be interesting to know what has caused the diminution of the parasites, whether parasites of the grasshoppers, dry weather or some unknown cause. It is probable that if we unravel the mystery we would find whether the indirect—perhaps very indirect cause. Kind Nature will eventually, perhaps soon re-establish the balance.

EXPLANATION OF PLATES.

Plate I.

1. Female of big-headed grasshopper.
2. Male of big-headed grasshopper.
3. Female of the lesser migratory locust.
4. Male of the lesser migratory locust.

Plate II.

1. Female of the pellucid locust.
2. Male of the pellucid locust.
3. Female of the two striped locust.
4. Male of the two striped locust.

Photographed from Nature by R. A. Cooley.

THE MAINTENANCE OF SOIL FERTILITY.

By Prof. F. B. Linfield, Agriculturist Experiment Station.

To the native, Montana is not alone the Treasure State but, with its valley farms, the richest agricultural state in the Union. But the Gallatin Valley farmer believes he has the garden spot of the state. He has, too, some very good reasons for thinking so. When a large field of barley threshes over 90 bushes per acre and several score acres of oats will return 125 bushels, while wheat under field conditions yields at times 60 to 70 bushels per acre there is some reason for the people of such a district to feel some pride in their locality. These yields are almost incredible to a new comer. The small experimental plat work at the Montana Experiment Station during the past season, (1902) shows results that confirm the most extravagant reports from the farmers of the valley.

There were 19 plats of oats, one-sixtieth of an acre in area representing as many varieties. The yield ranged from 90 bushels per acre to 174 bushels per acre, (32 pounds per bushel). The average was 137 bushels per acre. These results were very carefully checked so that there is no mistake on the totals.

The straw yield per acre for these oats was about four tons and the total crop was about six tons per acre.

The yield of wheat on the plats was also very large ranging from 53 bushels to 77 bushels per acre and averaged 60 bushels. The straw produced per acre was over four tons and the total crop about six tons per acre.

The barley yield was from 36 bushels to 96 bushels per acre and averaged 71 bushels. The yield of straw was 2½ tons and of total crop four tons per acre. These results were of course obtained on small plats and had the best of care, yet even under these circumstances the yields are much beyond results reported from other states. Surely no better proof is needed of the wonderful productiveness of the Montana soil and climate, and there is yet ample of both for many thousands of people.

In a Bozeman paper I recently noticed some comments by an old settler on farming in Montana. In his opinion wheat was

a good crop for the Montana farmer to grow. I believe with him that to grow the bread of the world is and will continue to be a good business for the farmer and I know of no place where he can get a larger return for his labor than on the Montana farm, if the farms of the Gallatin valley are a sample. Not alone for wheat but for all grain crops the acre yields are almost beyond belief.

From another source I heard of a farmer who had grown grain on his farm for many years. He was pursuaded to try a crop of clover. On breaking up the clover and again sowing a grain crop the yield of grain was increased 20 bushels per acre. He bemoaned the fact that he had for so many years lost so much grain; 20 bushels per acre. But why this increase in yield after the clover crop?

The experience of all old farming districts teaches that the continuous growing of wheat on any kind of land tends to reduce the fertility of the soil, or in other words it reduces the yearly crop from the land. The same fact is noticed from the continuous growing on any land of a crop of oats, of barley, or of rye. Scientific investigation has shown that these crops draw largely on the available nitrogenous ingredients of the soil, particularly as they require their nitrogenous food in a readily available form. A soil may be very rich in all the other elements required by the plant but the lack in any one element prevents the growth of a good crop.

As a rule the soils of the arid region are very rich in all the elements of plant food except the nitrogenous, and thus it is only in regard to the latter constituent that much care need be taken.

Fortunately we have a class of plants that have the power of gathering and storing in the soil this nitrogenous element of plant food. For very many years it has been known that clover and similar crops, (sometimes classed together as legumes) while storing large amounts of nitrogenous material in their substance yet left the surface soil actually richer in nitrogenous plant food than it was before the crop was grown. Various explanations were offered for this rather surprising fact but it was not until 1888 that a German, Dr. Hillriegel, offered the true explanation of the phenomenon. On the roots of clover and all leguminous plants, under ordinary conditions, are found small tubercles. These tubercles are the home of microscopic organisms which

have the power to, in some way, fed upon the free nitrogen of the air and store it for the use of the host plant, the clover, etc. I will not at this time explain how the above facts may be proven but any person who will carefully dig up a clover plant from a field where the crop grows well, wash and examine the roots, can readily see these little tubercules or nodules on the roots. The processes of nature are certainly wonderful. This element nitrogen, so unstable in all its compounds that it is the basis of all high explosives, and yet so important, that it is very closely associated with all the life processes of the plant and animal; this element is most largely fixed in nature by the micro-organisms which are found growing on the roots of leguminous plants. The clover stores the nitrogenous plant food, the wheat plant feeds upon this store and is thus enabled to produce the bread of the world. These two crops are in a measure complimentary to each other and their rotation on much of the land of Montana would insure in perpetuity a large crop of wheat.

Not alone is the clover crop a soil enricher but it also permits continuous cropping to be practiced while maintaining the soil fertility, thus avoiding the loss of a season's crop as is the case in summer fallowing. The clover crop also provides a valuable fodder for the feeding of live stock on the farm. For all classes of breeding stock, for cows and young stock, clover or alfalfa hay is the very best forage. Combined with grain it makes the basis of an excellent fattening ration for either sheep or steers as the experience of the Montana Experiment Station has demonstrated .

As a part of a fattening ration clover hay after allowing for the grain eaten at market prices has returned over $7 per ton, or with average Montana crops $30 to $35 per acre.

As yet no tests have been made with dairy cows or with young and growing stock at the Montana Station as we lack the facilities for this work. The experience of the writer in Utah, however, showed that with such stock much larger returns are possible as clover is much better adapted to feeding cows and young animals than it is for fattening animals.

The practice on many irrigated farms in Montana of growing two crops of grain and then summer fallowing means that the land is used two-thirds of the time. If instead of the summer fallowing a clover crop was grown, the benefits to the soil and to the grain crop would in the long run be fully as great, while the return from the land would be increased about one-third; at least such is the experience in other and older farming districts.

THE DRAINAGE OF ALKALI AND OTHER LANDS.

By J. S. Baker, Assistant Irrigation Engineer, Montana Experiment Station.

In the eastern states where rainfall is abundant drainage of agricultural lands is thought of as a necessity just as much as irrigation is in the West. As irrigation increases in extent and as time goes on it will not only be the problem to get water to the land but in many localities it will also be a problem to get the surplus water away from the land. There too are many places in the state where good lands are naturally swamped, but in many parts this condition may be easily traced to irrigation as a cause. This condition exists in some parts of the Bitter Root Valley, in some parts of the Gallatin Valley and especially in the Yellowstone Valley where thousands of acres of originally valuable land have been rendered valueless on account of an excessive amount of water in the ground. This condition may be attributed directly to two cases—seepage losses from canals and seepage from overlying irrigated areas. The losses from canals may be lessened by properly treating them, and the seepage from irrigated lands may be lessened by more sparing use of water. But the condition cannot be entirely prevented, nor will lessening these sources of seepage reclaim the lands that are now suffering. Therefore, it appears that few remarks on the subject of drainage might not be untimely.

According to the purpose, drainage is usually divided into three classes; road drainage, sanitary drainage and agricultural drainage. Road drainage and sanitary drainage although equally as important as agricultural drainage, are without the province of this paper, hence will not be further touched upon.

The purpose of draining farm lands as has been briefly mentioned before is to carry away the surplus water from the land. It may in some cases have for its primary object the carrying away from the soil obnoxious salts as will be hereinafter discussed.

The process by which plants are fed is a comparatively simple one. As water exists in the ground it may be classified as of two forms. First, hydrostatic, or ground water, and second, capillary water or soil moisture. It is from the former that the latter is supplied. The main body of water contained in the ground completely fills the voids and is subject to the laws of gravity and hydraulics just as much as water upon the surface. This body usually lies deep enough to be out of the reach of the ordinary farm crops. The fine pores in the soil above this exert a tension upon this water and draw it upward in thin films to the rootlets of the plants. There it is taken up and carried upward, through the plant, depositing its food in the plant, and evaporating or transpiring from the foliage.

It is when the supply is too great or the capacity of the soil for conveying away the water is too small that this hydrostatic or ground water is forced to the surface and a swamp is the result. And it is then that the necessity for drainage arises.

These underground waters will rise and fall as the supply is increased or decreased. Thus late in the season long after irrigation has ceased and before the Fall rains come some of the marshes and extremely wet places on the farms will disappear.

The same principles apply to the drainage of both swamps and alkali lands in so far as the disposition of the water is concerned, so it will not be necessary to say more about the former. The difference being that there is perhaps generally more water to be encountered in the swamps during construction.

As alkalies existed in the soil originally they were in most cases harmless to crops. These salts were distributed somewhat uniformly throughout sceveral feet in depth and no difficulty was experienced in growing crops thereon. As the water which seeps through the long stretches of soil from irrigated fields or from canals it dissolves the alkalies from the soil and carries them to the surface. The water is here evaporated and the salts are left deposited upon the surface. It is thus accumulated as time goes on until a thick crust sometimes from one-half to one inch in depth is left on the surface. There are very few crops, except such as Australian salt bush, which can grow in the presence of such large quantities of alkali.

There are two common forms of alkali—the black and the white. The principal ingredient of the black alkali is the carbonate of sodium. This is the most injurious to crops as it is

so strongly alkaline. This may be mixed with gypsum for about four years by sowing the latter broadcast upon the affected spots. This process changes it into the less harmful white alkali.

The white alkali is composed chiefly of the sulphate of sodium, commonly knows as Glauber's salt. This is less harmful than the black alkali, but still few crops can thrive when it is present in large quantities.

There are several methods of reducing or neutralizing this but the best method seems to be to remove it entirely by a system of either open or under drains.

Before a system of drains can be planned it is perhaps well to know what quantity of water is to be removed in a given time, as in a day. Estimates are usually based upon from one-eighth of an inch to an inch in depth over the entire surface each 24 hours. That is this depth of water that would be drawn off the land each day. The following table gives the number of cubic feet per second, and the miner's inches per acre for the various depths.

Table No. 1.

Inches deep.	Cubic Ft. Per Second.	Miner's Inches.
1/8	.0052	.208
1/4	.0105	.420
1/3	.0140	.560
1/2	.0210	.840
3/4	.0315	1.260
1	.0420	1.680

For ordinary land it is safe to compute the quantity of water on 1/3 of an inch in depth per acre or .560 of a miner's inch. To get the quantity on any field multiply .560 by the number of acres in the field. For example, suppose the field contained 20 acres. 20 times .560 equals 11.20 miner's inches. For 40 acres, 22.40 miner's inches, etc.

In order to dissolve the alkali on the soil the land is divided up into small areas and an embankment raised up around each. The embankment is of sufficient height to hold water to about four inches deep. Water is then turned into these basins and allowed to stand for one or two days and is then drawn off by means of the drains.

The greatest success have been obtained by the use of tiles in Egypt and other countries where drainage has been practiced for this purpose. In that case the water is allowed to stand until it drains off itself through the tile pipes. The accompanying figure illustrates the method of laying out the land.

Sometimes it is not convenient to procure tile for drains and open drains are resorted to. And sometimes they are preferable. The accompanying diagram shows the method of building these basins and drainage ditches.

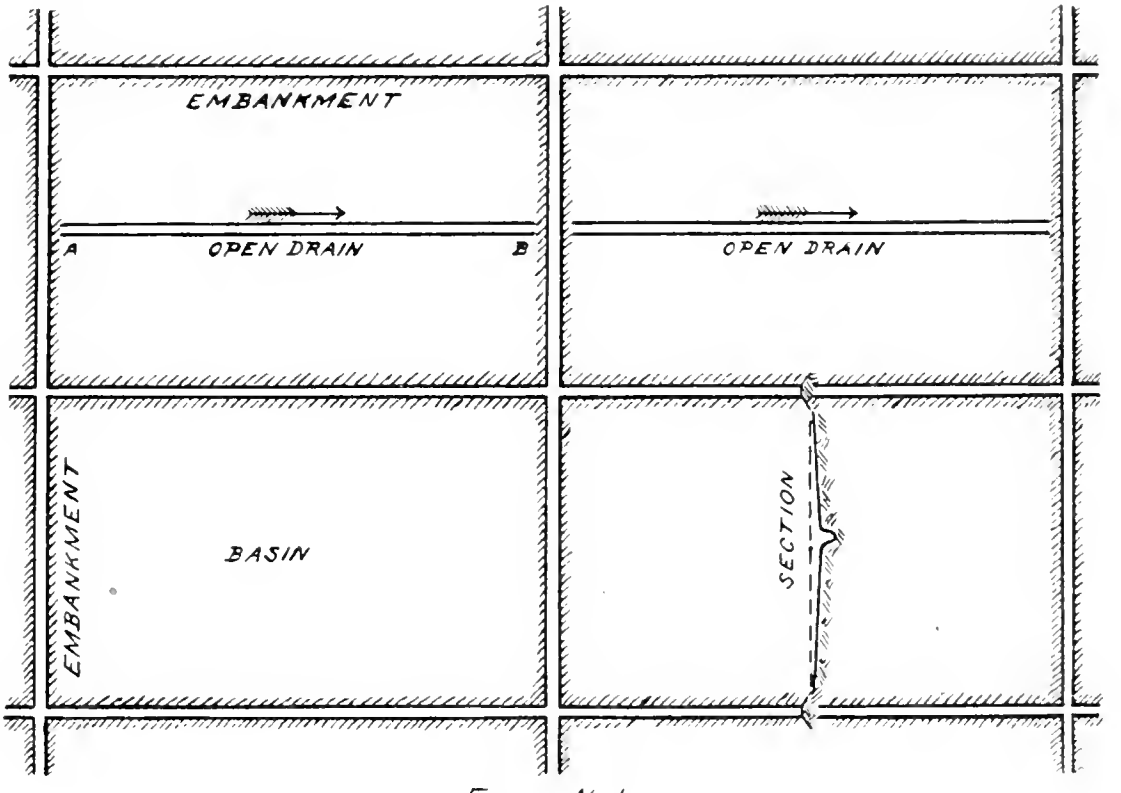


Figure No 1

The water is turned into these basins from the irrigation laterals to a depth of about four or five inches and allowed to stand for about two days. The embankments are then cut at A. B. and the water conducted to the main drains.

Sometimes it will be sufficient to run the lateral drains in parallel lines joining the main, flood the land without building the check or basins and allow the water to run directly into the open drains.

The following tables No. 2 and 3 give the discharges of various sized drain ditches for different grades, in miner's inches and the number of cubic yards of material for different sized channels, respectively.

Table No. 2.

Discharge of Open Drains in Miner's Inches for Different Grades and Cross-Section. Side Slopes 1 :1.

Bottom Width 2 feet.

Grade in feet per 1000 ft.	Depth of ditch 3 feet / Depth of water 1½ feet	Depth of ditch 3½ feet / Depth of water 2 feet	Depth of ditch 4 feet / Depth of water 2½ feet	Depth of ditch 5 feet / Depth of water 3 feet	Depth of ditch 6 feet / Depth of water 4 feet
1	324.	576.	928.	1560.	2511.
2	460.	822.	1328.	1962.	3686.
3	556.	1008.	1606.	2400.	....
4	651.	1168.	....	....	....
5	724.	1296.	....	....	....
6	804.	....	....	....	....

Bottom Width 3 Feet.

Grade in feet per 1000 ft.	Depth of ditch 3 feet / Depth of water 1½ feet	Depth of ditch 3½ feet / Depth of water 2 feet	Depth of ditch 4 feet / Depth of water 2½ feet	Depth of ditch 5 feet / Depth of water 3 feet	Depth of ditch 6 feet / Depth of water 4 feet
1	451.	780.	1226.	1771.	3192
2	642.	1112.	1754.	2520.	4568
3	783.	1348.	1991.	....	....
4	907.	1568.	....	....	....
5	1012.	....	....	....	....

Bottom Width 4 Feet.

Grade in feet per 1000 ft.	Depth of ditch 3 feet / Depth of water 1½ feet	Depth of ditch 3½ feet / Depth of water 2 feet	Depth of ditch 4 feet / Depth of water 2½ feet	Depth of ditch 5 feet / Depth of water 3 feet	Depth of ditch 6 feet / Depth of water 4 feet
1	577.	989.	1506.	2184.	3878
2	825.	1416.	2147.	2961.	....
3	1003.	1718.	2628.	....	....
4	1162.	....	....	....	....
5	1300.	....	....	....	....

Bottom Width 5 Feet.

Grade in feet per 1000 ft.	Depth of ditch 3 feet / Depth of water 1½ feet	Depth of ditch 3½ feet / Depth of water 2 feet	Depth of ditch 4 feet / Depth of water 2½ feet	Depth of ditch 5 feet / Depth of water 3 feet	Depth of ditch 6 feet / Depth of water 4 feet
1	628.	1193.	1823.	2511.	4536
2	1006.	1708.	2595.	3686.	....
3	1232.	2078.	....	....	....
4	1424.	....	....	....	....
5	1591.	....	....	....	....

Bottom Width 6 Feet.

Grade in feet per 1000 ft.	Depth of ditch 3 feet / Depth of water 1½ feet	Depth of ditch 3½ feet / Depth of water 2 feet	Depth of ditch 4 feet / Depth of water 2½ feet	Depth of ditch 5 feet / Depth of water 3 feet	Depth of ditch 6 feet / Depth of water 4 feet
1	846.	1427.	2151.	3135.	5200
2	1206.	2035.	3043.	....	....
3	1476.	2349.	....	....	....
4	1710.	....	....	....	....

Table No. 3.

Table of Cubic Yards per Foot of Length for Open Drains, for Side Slope of 1:1.

Depth in feet	Width of Ditch at Bottom in Feet				
	2	3	4	5	6
3	0.555	0.667	0.778	0.889	1.000
3.5	0.713	0.843	0.972	1.102	1.231
4	0.889	1.037	1.185	1.333	1.481
4.5	1.083	1.250	1.417	1.584	1.748
5	1.296	1.481	1.667	1.852	2.037
6	1.778	2.000	2.222	2.444	2.667
7	2.333	2.593	2.852	3.111	3.370

In excavating the drains work must begin at the lower end and work toward the head, so that the water may drain off freely.

The chief advantages of open drains are that they will carry off a large amount of water and will take care of the water of excessive storms and floods. But they are objectionable for the following reasons: They are wide and take up a large amount of land in the ditch itself and in the waste banks. They have to be deep and cannot be crossed by farm machinery. They necessitate frequent bridging in order to cross from one side to the other. They are expensive to build on account of the large amount of excavation. They have to be cleaned of sediment very frequently in order to keep them efficient.

Tile Drains.

If a system of tile drains is decided upon, the first thing to be done is to locate the mains, submains and laterals. These should as far as possible, follow the natural drainage lines of the field. The mains following the drains on the surface and the submains following the drains running into these, and the laterals following the slopes of the sidehills running into these. The laterals are always laid with the steepest slope of the land.

If the field be small the main may be laid along one side of the field and the laterals all join in parallel lines as shown in the following figure.

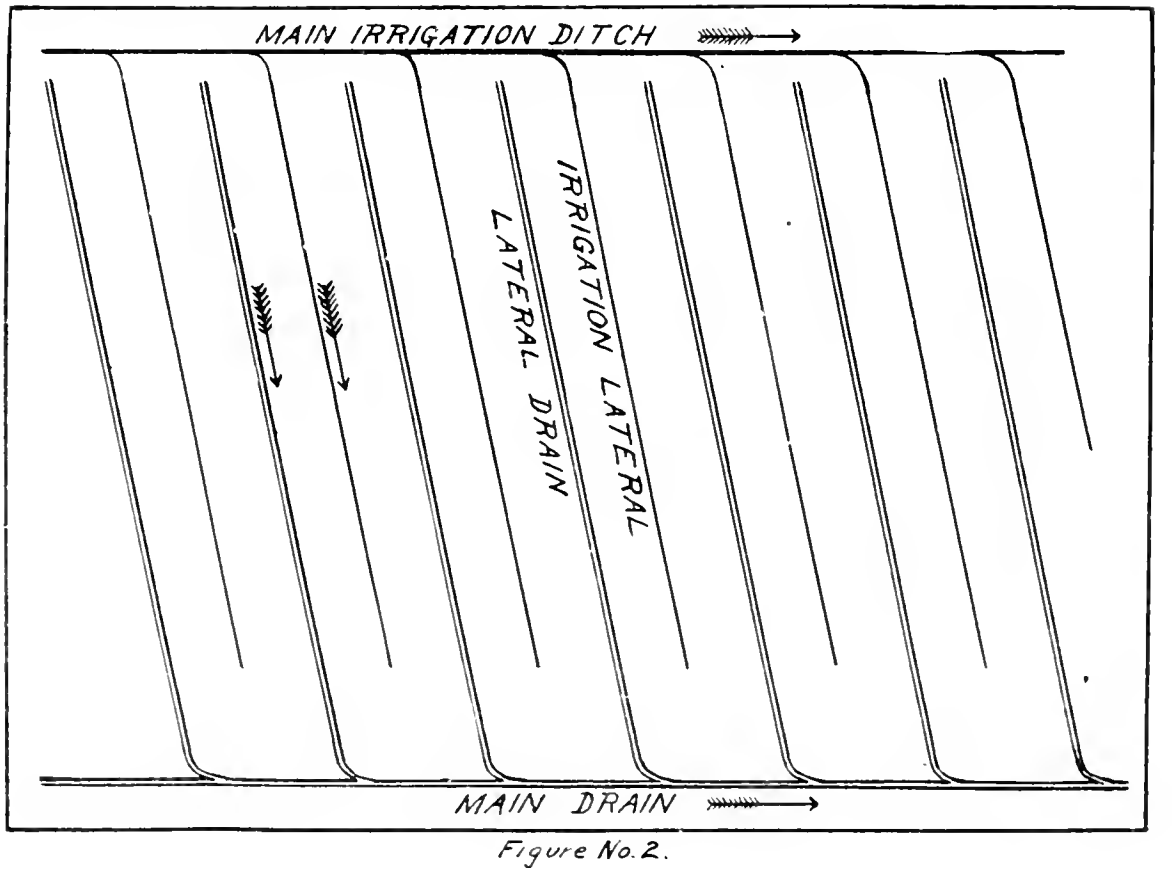


Figure No. 2.

The irrigation water would enter from one corner of the field and the drainage water leave at the opposite corner. The double lines represent the location of the drains and the single lines represent the irrigation ditches.

Table No. 4.

Showing Discharge in Miner's Inches for Various Sizes of Tiles on Different Grades.

Fall in inches per one hundred feet	Two-inch pipe Discharge in miner's inches	Three-inch pipe. Discharge in miner's inches	Four-inch pipe Discharge in miner's inches	Six-inch pipe Discharge in miner's inches	Eight-in. pipe Discharge in miner's inches	Ten inch pipe Discharge in miner's inches	Twelve-inch pipe. Discharge in miner's inches
1	.....	.....	.....	.....	.....	25.6	42.4
2	.....	.....	.....	.....	19.6	36.4	60.3
5	.....	.....	.....	12.5	27.9	52.0	86.1
7	.....	.....	4.8	15.3	34.3	63.7	105.5
10	1.3	2.9	5.6	17.7	39.6	73.5	121.7
12	1.4	3.3	6.3	19.8	44.3	82.3	136.3
24	2.1	4.8	9.0	28.0	62.6	116.3	192.7
36	2.6	5.9	11.0	33.4	76.7	142.5	235.9
48	3.0	6.8	12.7	39.6	88.6	164.6	271.9
60	3.3	7.6	14.2	44.3	99.1	184.1	304.7
120	4.7	10.7	20.1	62.7	140.2	260.5	431.3

Depth and Distance Apart.

The depth and distance apart of the lateral drains are largely dependent upon the nature of the soil and the relation with each other. If the soil is a very porous one they do not need to be placed closer than 100 to 200 feet. On the other hand in clay soils it some times becomes necessary to place them as close as 20 feet. Again in two soils of the same retentive powers, the deeper the drain (within certain limits) the greater may be the distance apart. It may be well to say that they should be placed from 2 to 6 feet deep but most ordinary three feet.

It might also be said for clay soils, they should be spaced from 20 to 40 feet, in sandy soils 40 to 100 feet, and in gravelly and sandy soils from 50 to 150 or 200 feet.

The following tables taken from Prof. Charles G. Elliott's "Engineering for Land Drainage" gives the number of feet of tile per acre for different spacing.

Table No. 5.

20 feet apart	2,205 feet
25 feet apart	1,760 feet
30 feet apart	1,470 feet
40 feet apart	1,102 feet
50 feet apart	880 feet
100 feet apart	440 feet
150 feet apart	270 feet
200 feet apart	220 feet

This estimate is for laterals only, and does not include the intercepting mains.

In computing the size of tiles for the system, it is first necessary to find the number of acres to be drained by the main. This may be found by the use of Table No. 1. Then the size of pipe to be used may be found from table No. 4 for this given discharge and knowing the grade or fall. Then the size each of the branches to this main may be computed in the same way, and finally the sizes of the laterals. Of course the laterals will be the smallest of all the pipes and these may taper from the upper end to its junction with the sub-main by means of taper lengths of tile. The smallest tile to be used for a lateral may be placed at 2 inches in diameter.

Kinds of Tile to be Used.

The best form of tile is a circular one. Thus there need not be any special kind of trench used in which to lay them, and they may be turned so as to give the best fitting joints. In selecting the tile care should be used. Rap them with a knife blade and a good well-burned tile will give a ringing sound. The tile should not be too much checked or cracked and should have a fairly smooth surface on the inside. They should also be straight, for the use of crooked rough tile will necessarily reduce the discharge on a given grade.

Staking out the Ditches.

A stake is located at each end of the particular lateral, main or sub-main, about 1 foot to one side of the proposed ditch. The tops of these stakes are placed at the same distance above grade at each end and the intermediate stakes lined in by sighting from one stake to another. The tops of the intermediate stakes may be driven to grade line in the same operation.

Excavating the Trenches.

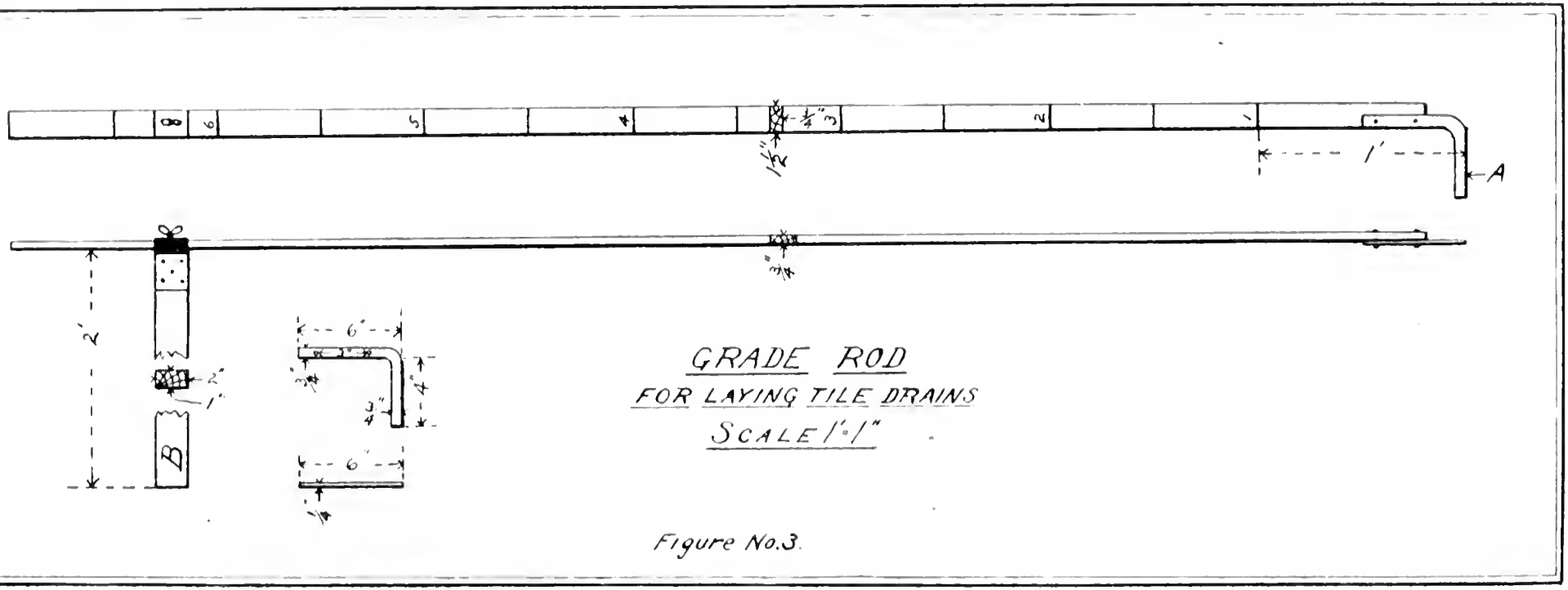
The trenches are dug by beginning at the bottom of the sys-

tem and working up toward the head. This is best done by means of drainage spades having long blades. The last spading is done with a round mouth spade to fit the tile. After about four feet have been excavated the trench is cleaned out with a cleaning scoop of the proper size to fit the tile which is to be laid. The following table gives the number of cubic yards of excavation per foot of trench.

Table No. 6.

Depth In Feet	Width of Trench in Inches				
	10	12	14	18	20
2	.061	.074	.086	0.111	0.123
2.5	.077	.092	0.108	0.138	0.154
3	.092	0.111	0.129	0.166	0.184
3.5	0.108	0.129	0.151	0.193	0.216
4	0.123	0.148	0.173	0.222	0.246
5	0.154	0.185	0.213	0.277	0.308

The grade should then be tested. A garden or mason's line is stretched along the top of the stakes and a grade rod shown by figure No. 3 is used letting the bottom of the hook "A" rest on the bottom of the trench and the movable arm "B" come down to the garden line. The tile is then laid with the joints closely abutting. Care should be taken to place them so that no joint exceeds ¼ of an inch. Wet clay or loam is then carefully packed around the tiles by hand, so that they will not be displaced when the backfilling is done. This is called blinding the tiles. Great care should also be exercised in grading; for if an upgrade exists in the line the water will flow out of the joints instead of entering them. The following Table No. 7 taken from Prof. Elliot's work gives the smallest grade and the limit of length to which various sized tiles can be laid. For example a 6-inch tile cannot be laid on a grade of .05 of a foot 100 feet for more than 2,500 feet.



GRADE ROD

FOR LAYING TILE DRAINS

SCALE 1"=1"

Figure No.3.

Table No. 7.

Limit of Size of Tile to Grade and Length.

Sizes of Tile in inches	Minimum Grade per 100 ft.	Limit of Length in feet.
2	.10	600
3	.09	800
4	.05	1,600
5	.05	2,000
6	.05	2,500
7	.05	2,800
8	.05	3,000
9	.05	3,500
10	.04	4,000
11	.04	4,500
12	.04	5,300

When a junction is reached the proper branch joint should be placed in and the upper end plugged to await the laying of that line. "Y" junctions should always be used and a little additional fall given the laterals where they enter the sub-mains and to the sub-mains where they enter the main.

When a lateral is finished the end should be plugged by laying a stone or piece of flat brick or tile over the end to prevent mud from entering.

The outlet should be covered with a screen placed over the end of the pipe to prevent animals from entering. The last ten feet should be laid with vitrified pipe instead of the tile pipe and the joints be laid in cement mortar.

After the tile system is laid the land may be laid off into basins as before described and the water allowed to stand until it drains off of its own accord. Or the land may be simply flooded. The former method is to be preferred. The process may be repeated several times in one season. In the course of from two to three years the land will be fully reclaimed.

The drains of course will be left remaining in the ground. Their action very much improves the land by draining off the surplus ground water and allowing the soil to become thoroughly ventilated.

IRRIGATION INSTITUTIONS.

By W. W. Gamble, Choteau, Montana.

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1. Personal.

May it please this audience!

I came from a ranch, and as you all know, the isolation of ranch life is not very conducive to fluency of speech. I have sometimes written articles for the agricultural papers; and this has been the occasion at rare intervals of putting me on the platform. But I am, upon such occasions, deeply sensible of the fact that because a man can write, it in no wise follows that he can also talk.

Then the subject that I am to talk about, "Irrigation" Farming as an Economic Question," and here that there may be no misunderstanding of the subject or confusion of thoughts about the object of my remarks, I will state, that the object and aim of my talk will be to show, **that irrigation farming, and the consequent establishment of irrigation institutions will alter the economic and social conditions of this country.** In other words, this will be a talk about the underlying principles of Irrigation Institutions.

In presenting so grave a subject I have the feeling that every person in this audience may not be impressed by it. Economic questions in general, weighed down as they are with grave questions of human destiny may not interest an ordinary audience, as such questions may not be understood without some previous study and preparation. But Western audiences are not ordinary audiences because they are more keenly alive to new questions than are the audiences of anywhere else. There was a time when New England was the center of the agitation of all things new. But this has changed, and the storm center of such discussions has moved, like the center of population, from the East, out into the West. And for my purpose I am glad to remember that Helena is a long way west.

2. Introductory.

I will now say something upon a very broad subject indeed:

You may have heard the expression: "All knowledge is one." And I suppose that educators upon advanced lines of thought must have in mind the universal character of knowledge, when they advance such a broad assertion as this. We may modify it for our use by saying that many persons who have studied economic questions have come to the conclusion that there is some common goal upon which all lines of economic thought converge. Say, for illustration, some great reservoir of human energy toward which all events are moving. Some, who have thought much upon the subject, say, "Socialism is the world's object of effort." Socialism is not, however, the ultimate goal of human society. **This cannot be!** But whether it be industrialism, or Socialism or Capitalism, and the three are of the same nature, or whether it be a combination of all three, that should go to make up the road we should be traveling. The reconstruction of the state, made necessary by the approach of new economic conditions must have a practical tendency and come as a result of institutions upon the statute book of the State, registering the results of actual experience and careful experiment.

3. The Ray Bill.

By way of illustrating what I have to say, I will take as an example, something that is presented for our consideration here at home. A bill was introduced into the legislature of Montana, at its last session that has been too little understood by the people of the State. This bill is known as the Ray bill and seeks to provide irrigation institutions for the State. It was not drawn by theorists but by practical men, who, in drawing it had no thought of economic or social questions but were simply striving to present to the State practical rules for the government of irrigation and it is curious to observe how clearly the practical experts in irrigation have tracked the best lines of economic thought.

With that part of this bill, that on measures carrying out the details of control, the creation of a state enginer and the machinery of administration we have, for our purpose, nothing to do. But in making this bill its authors thought it necessary to state, what they considered to be the correct principles of irrigation institutions, and here we have something that is very interesting indeed. Fortunately for us, the principles presented

are briefly stated, to the point, and apparently cover the whole ground. In fact, they may be summed up in three lines and in the following order, to-wit:

(1) The assertion of ownership of water by the State.

(2) The connection of water with the land, for purposes of use and transfer.

(3) The doctrine of beneficial use as the basis of right.

4. State Ownership of Water.

The subject of ownership of water by the State, and in the term State is of course the Nation and municipality as the case may be, we have not time to discuss. **It is a part of the great question of** public ownership. This question is in the air and nearly everybody has considered it. (There has been a suggestion of it in most of the adjustments of differences between capital and labor, in the struggle of wealth against commonwealth and of monopoly and the people.) **The theory of State ownership of water** for irrigation purposes upon farms is similar to the theory of municipal ownership of water for domestic purposes in cities and the general principle of public ownership may be stated in this way: The common law is in a certain sense communistic, as it makes the right of private property like all other political rights subservient to the public welfare. **This is the principle that is embodied in irrigation institutions.**

5. Connection of Water with Land.

The theory of the connection of water with land, has so far as I know, never been discussed. It is a new question in economics. The operation is so simple that it seems to us almost like a mere mechanical conclusion, and yet, few questions that have arisen since the organization of our government will have more far-reaching consequences than this. Water is of the same economic nature as land, as I will endeavor to show later on, and the principle that applies to the connection with irrigation institutions in this. In the old law of England, which has never been changed, the principle is clearly laid down that land is public property vested in the Crown, that is, the government is trustee for the public benefit. In our country the supreme power of the monarch has been replaced by the supreme power of the people, that is to say, the Monarch's supreme ownership of the land by the people's supreme ownership of the land.

6. Monopoly.

The application of this principle to irrigation institutions may not be readily seen. To make it plainer, we will examine another subject intimately connected with it. At every advance toward new economic conditions there is an opposition and whether it be an effort to secure for consumers a reasonable price for coal in Pennsylvania, or to secure for producers a reasonable price for beef in Montana, it is all the same. This opposition we recognize under the general name of Monopoly. Now as we are dealing in principles, we will state the principle to all monopoly. If we must have monopoly and monopoly has come to stay, then, while public monopoly is a blessing, private monopoly is also a curse.

An examination of the nature of monopoly reveals to us the fact that monopolies are of two kinds, natural and artificial. Natural monopiles gravitate invariably to single ownership and control and the list of natural monopolies, waterways, harbors, light houses, railways, telegraphs, telephones, water works, gas works, and street cars of all kinds.

7. Artificial Monopolies.

You can give no list of artificial monopolies. They are anything, not by nature a monopoly, that is made so by the favor of a natural monopoly, thus, soliciting baggage in a railway depot is not by nature a monopoly, but if the company allows but one person to so solicit baggage it becomes an artificial monopoly. Refining oil or sugar, is not by nature a monopoly but by the favor of the natural monopolies of railways these competing pursuits may be made artificial monopolies.

8. Land.

But the point I am getting at is this: There is one natural monopoly so vast that it has not been included in the list, but requires a separate treatment of itself. **This is land!** Now this is of very great importance in the discussions of the subject we are trying to illustrate. We have time only to say: That water, whether used for domestic purposes in a city or for irrigation farming in the country **is a natural monopoly.** Now you see if you connect water with land for the purpose of use and transfer, apply to it the theory of public ownership, and then lay down the rule of law that beneficial use is the basis of right you have the main principles underlying irrigation institutions and you

also have in a nut-shell the main principles that underlie most of the economic discussions of our time.

9. Beneficial Use.

There now remains but the doctrine that beneficial use is the basis of right, for us to discuss. This principle has been incorporated in irrigation institutions and is there to stay. The principle firmly established in statutory law becomes an object lesson of correct political, legislative, social and moral ideals and by a parity of reasoning will be applied to all monoply, wherever found, natural and artificial as well. This is no chimera of mind, no effort of the imagination, nor is it anything of a dream.

10. National Irrigation Act.

I have used the Ray Bill as an illustration of irrigation institutions because it was something here at home that ought to be studied. But this bill presents irrigation institutions as they are and not what somebody supposed they ought to be. The authors of the bill were evidently so impressed with the necessity of harmony between the State and the National Government in irrigation institutions that they embodied the principles of the National Irrigation Act in the bill which they presented to the State Legislature for its action and it is those principles that I have been discussing. The National Irrigation Law reads as follows:

11. Section 8.

Section 8. "Nothing in this Act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use or distribution of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the provisions of this Act, shall proceed in conformity with such laws and nothing herein shall in any way affect any right of any State or of the Federal Government, or of any land owner, appropriator or user of water in, to or from any interstate stream or the waters thereof: Provided, that the right to the use of water acquired under the provisios of this Act shall be appurtenant to the land irrigated, and **beneficial use** shall be the **basis**, the **measure** and the **limit** of the right."

It will be observed that the National law clearly recognizes three things: **The ownership of water by the State. The nat-**

ural connections of land and water and the theory that beneficial use is the basis of right.

12. Conclusion.

In Conclusion I would say. That while it is not stated that the establishment of irrigation institutions will have an immediate effect upon the general institutions of the States, the mere fact that certain principles have all along been recognized as correct by the common law will speedily leaven, once the movement is started, the whole mass of statutory law in the land.

We are living upon the verge of great events, of great discoveries in electricity and the domain of science, and of the adoption of new ideals in the political codes of states. Great questions of labor and capital will arise—have arisen—and this country will become—it has become—a vast arena, upon which great social and moral reformers will put forth the might of their genius, while the country is shaken with the excitement of social discussion. Under such conditions it will be well for us if we can proced as cautiously, and carefully and with as little disturbance as has been the case in the establishment of irrigation institutions.

12. Emmigration.

Emmigration has, since the dawn of history, moved westward, and ever upon its course it has given back to the East new ideals of politics and legislation. This emmigration is now gathering upon the eastern shores of that American Mediterranean, the Pacific Ocean, preparing for new conquests, and the first great political result of its deliberations is the sending back to the East of new ideals embodied in irrigation institutions for the consideration of the world. These new ideals it is claimed will place the question of public ownership in such a light that it can be understood. It will bring the land question into prominence and also suggest a remedy for the encroachments of Monopoly.

And by the assertion of the doctrine of beneficial use as the basis of right, they offer a suggestion for a peaceable solution of the social questions of the day, including the labor and other industrial questions.

ANNUAL ADERESS BY G. R. FEATHERLY,

President Beaverhead Farmers' Institutes.

Gentlemen, I greet you. It is with no little pleasure that I come before you to-day. One year ago this organization came into existence, and it looked at that time as though the association was bound to become quite a flourishing one. But alas, this enthusiasm was only short lived and was soon forgotten by most of those present and I will inform you right here that it was impossible to get a quorum of the executive committee together at any time during the year. This was rather discouraging to me. But I was president and did not intend to let it die on my hands, so together with one or two of the faithful, we have been able to keep it alive.

This, gentlemen, is a deplorable state of affairs. Just think of it awhile. Why we are living in an age of progress; when every branch of industry is forming trusts, unions and associations, all for mutual protection. How is it with your Uncle Reuben? Is he not 'way back some place sitting down? Yes. Some one has told him to do it and he, ever obliging, has done it. This has been going on ever since man began to till the soil. We have just given what was asked for what we buy, and taken what we can get for what we can have to sell. This is all wrong, but it will continue to be so as long as we continue to work alone and rush into market with our products and take just what we can get, regardless of cost of production.

If we wish to be to independent people that we are called, we must change all tihs. How? Band together, put a legitimate price on our products and we will surely get it. We have at our command the power that sustains the earth. See the vast capital we have in our great fields of wheat and other grains, our orchards, vineyards and gardens; the great herds of cattle, horses and sheep, besides the numerous other products that are directly and indirectly the products of the soil and of the toil of the farmer. We have in these a capital greater than that of all the great trusts and combines together, and only a little thinking

will bring to your mind what could be done by the farmers, should they combine as other branches of industry have done, and gentlemen I believe that most of us will live to see the day when the farmers will combine and I pray that the day will come quickly. The way for us to bring this about is to keep working away, each in his locality, not losing sight of the end, as we see it.

It is hardly necessary to call your attention to the failing of cattle and other products of the farmers. Hay went off at $1.00 per ton; oats 25 cents per hundred; steers from $5.00 to $10.00 per head since one year ago. The conditions are not such as to warrant such a slump. If we had a strong organization I think these things could be regulated.

I wish to speak of things that were projected at our meeting last year and failed for lack of support. First the fair. A committe was appointed, but could not get to work. We are all agreed that we ought to have a county fair and that a great deal of good would result from it. Then we talked of a book to contain all of the brands of the county. This was acknowledged to be a good thing by all, and about 25 or 30 ranchmen sent in their brands, not even enough to get a start, and this after repeated requests had been made. We would be pleased to hear some talk on this later. Another measure was a flouring mill, something that is very much needed in this valley. Of course, as long as we can get a good price for oats we will not think of raising wheat, but we can raise good wheat and get good yields. No, we have nearly lost Butte as an oat market unless we are willing to sell at a figure less than it costs to produce. We have been very fortunate in finding a market south for our oats the last two seasons, but we can't always figure on this market. So, if we had a flour mill, we could raise wheat and what oats will bring a better price. The railroad company does not always use us right in regard to rates. We might be able to treat with them if we work together. The last but not least question is water. We are all aware that there is not enough water for all. Then it is time that we should begin to look for some way of replenishing our supply. This can only be done by a system of dams or reservoirs, and we have good dam sites on all of our little creeks. Then we have, up on the Redrock, one of the best reservoir sites to be found in the world. Enough water can be stored there to give us all the water that we will ever want in this locality. That is from the dam site to Twin Bridges. There are only a

few ways in which this dam can be built. The Government can't take it up because there is not enough new land to be reclaimed, and you might say the same of private capital. Then you come to the plan of the dam being built by the ranchers or water users. How could this be done? Suppose the dam will cost $40,000 or $50,000. Let each man pay so much an inch, say $.50 or perhaps it would take less, on the water that he has recorded or has a decree for. This would have to be general. leaving none out. This plan is, I think, feasible, and could be made to work and at a very small outlay of money to each individual. It is the only way to solve this great question. We may have enough water this year, but I think you will find when we are ready for our second irrigation that we will be short of water again. I have heard a number of gentlemen say that they would give $1,000 towards building that dam. The site is now owned by a Butte company and perhaps could be bought at a reasonable figure. It would be cheaper to put a few hundred dollars into this dam and have plenty of water, than to put it into law suits and not to get any more after the court says it belongs to us. I hope you will look into this proposition, and keep it moving. Now, gentlemen, I leave all these questions with you for your earnest consideration as well as any others that may be brought before you at this meeting.

OUR WORK—ITS SCOPE AND PURPOSE.

By President James Reid, Agricultural College.

Strange as it may seem, there is still a great deal of misunderstanding as to the work which these Agricultural and Mechanical Colleges were intended to do. There are several very urgent reasons why the general public should understand much better the purpose for which they were established. The endowment given them by the national government makes them public institutions in a peculiar sense. These colleges are the direct result of an enlightened national policy which recognizes that the interests of liberty and the state are best subserved by the liberal and practical education of the citizens.

Of late years there has been a much better understanding on the part of the public as to the object and aims of these institutions and as a result their growth has been rapid and their usefulness is being greatly extended from year to year.

While these institutions draw their support in large measure from the Federal Government, yet such restrictions are placed upon the uses to which the Federal funds may be applied, that a generous support from the state is essential.

The Montana Agricultural and Mechanical College receives from the Federal Government twenty-five thousand dollars yearly while the yearly income from the land grant amounts to about ten thousand per year.

These funds can be used only for instruction and equipment but must not be used for new buildings, or repairs of any kind, nor for furniture, heating, lighting, stationery or expenses of administration. The College must look to the State for funds for all purposes where the Federal funds cannot be used.

As to the work which these colleges are intended to do: the First Morrill Act prescribes the work as follows. "The leading object shall be, without excluding other scientific and classical studies and including military tactics, to teach such branches of learning as are related to Agriculture and the Mechanic Arts,

in such manner as the legislature of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the various pursuits and professions of life." The Second Morrill Act was approved August 30, 1890. Under the provisions of this Act the College receives yearly a cash endowment of twenty-five thousand dollars. This Act states explicitly that the money appropriated by it is "to be applied only to instruction in Agriculture, the Mechanic Arts, the English language, and the various branches of mathematical, physical, natural and economic science, with special reference to their applications in the industries of life, and to the facilities for such istruction." The lands, buildings, and all repairs, furniture, cases, shelving and the ordinary appliances of a College must be provided from other sources. In other words, the acceptance of the aid provided for by the Morrill Acts implies that the State is ready to give generous maintenance to these colleges.

The primary purpose of the Morrill Acts is the advancement of Agriculture and the Mechanic Arts. They seek to promote the "liberal and practical education of the industrial classes." It is very evident that the intention of Congress was to make the Acts broad and comprehensive so that these agricultural and mechanical schools should not be strictly and solely technical, but that they should secure the facilities and advantages of a liberal as well as practical education to the industrial classes.

Two Distinct Lines of Work.

There is no doubt that the intention was to offer two distinct courses or lines of work, the one agricultural and the other mechanical. There should be good preparatory work in language, mathematics and science. There should be enough of Latin at least to make the English work of the greatest possible educational value, and to make clearer the meaning of scientific terms. Under present conditions, a reading knowledge of French or German, or both is essential to advanced study in Agricultural or Mechanical subjects. A thorough knowledge of physics and chemistry is of very great importance. Liberal courses should be offered in biology so far as it is related to farm life and farm economy; as, for example, economic entomology, structural and physiological botany, zoology and ornithology, so far at least as they are related to the farm and its interests. Any agricul-

tural course should include subjects which look to the equipment of a good citizen as well as a good farmer.

The courses in Mechanic Arts should include four year courses in Engineering which should be so thorough and complete as to enable the graduate to enter the ranks as a skilled mechanic, draftsman or engineer.

A thorough study of our various departments and courses will show how we are endeavoring to carry out the design of the Morrill Acts. The practical feature in instruction is emphasized, the students being required to put into practice as far as possible, through the aid of well equipped shops and laboratories, the instruction he receives. The aim is to combine the theoretical and practical in every department.

The College offers General Science Courses, also courses in Agriculture, Civil, Mechanical and Electrical Engineering, each extending over four years and leading to degrees. The art department also offers a four year course.

The Preparatory Department has three courses each extending over three years. The entrance requirement to these is that the student shall have completed the work of the eighth grade.

Th student may take the regular course which is the equivalent of a High School course or he may choose to take either of the courses, also of High School grade, in Agriculture and Domestic Science.

The Business Department of the College offers very practical courses in Bookkeeping, Stenography and Typewriting.

Short Winter Courses are given in Agriculture and Engineering and extending over two winter sessions of four and one-half months each.

The Department of Music has been growing from year to year until now it has over eighty students enrolled and has one teacher of voice and three in piano. The department is self-supporting, no public funds being used to maintain it.

Referring to some of the courses more in detail, the College course in Agriculture gives an opportunity to specialize in Agronomy, Animal Husbandry or Horticulture. The time has come when the farmer should rank among the most intelligent of our citizens. This course is designed to give culture, special agricultural training, and to give in addition a broad scientific education.

In the College Engineering courses, the first two years are alike for all, and then differ in mechanical, civil and electrical lines. The professional engineer should be a man of broad general culture.

The technical requirements of these courses are so heavy that the student has but little time for studies that are intended to give culture, but as far as possible such studies are introduced. In the arrangement of the work, the courses have been based upon those of the leading engineering schools of the United States. It is the aim of the College to develop the practical faculties of the students in whatever line they may choose. In nearly all courses a generous amount of work is given in iron and wood. It consists in making useful articles for the household and the farm.

A FEW THOUGHTS FOR FARMERS, ASIDE FROM FARMING.

By J. A. Lovely of Park County.

"It seems to be a common opinion among farmers that no great advantage is to be derived from attending Farmers' Institutes for the reason that each individual is assumed to be in a better position to understand his own environments, character of his soil, crop best adapted to it, etc., and therefore to be in no need of instruction as to how manage his farm.

Of course such persons regard the farmers' institute merely as a school of instruction in the art of farming, which assumption is justified by most such meetings, since they are so rare among us, and no effort has been made to cover a broader field.

Merely as a school for instruction a well conducted farmers' institute cannot fail to be of value to any farmer, for the reason that he is sure to get some new ideas that are of value to him; but a permanent organization of farmers, organized and rigidly maintained for the general betterment of their condition would be of great benefit—in fact it seems to me that the conditions are fast becoming such that it will shortly be a necessity.

While farming is naturally the most profitable occupation in which one can engage—in fact on it rests the entire fabric of prosperity—on account of the burdens placed upon it, it brings the smallest net financial returns. The expense of a great war is to be met and the bulk of it is exacted from the farmer; infant industries are to be reared and the farmer is called upon to supply most of the nourishment; some philanthropist desires to found a benevolent institution, a college, or supply the cities of the world with libraries, to all of which the farmer contributes at least his fair proportion. In order to prevent competition and control the price of labor, the manufacturing, mining and transportation industries form their combinations; while to resist the oppressions of those combinations of capital, labor combines and claims its proportion; our local merchants must protect themselves by exacting higher prices for their wares, which the farmer must pay along with the rest, although he receives no compensating returns. If he wishes to sell he must take what he can get. If he wishes to buy he must pay the price asked.

During the twenty years previous to 1900 the entire wealth of the country increased more than 125 per cent, while the value of farms and farm property alone increased only 70 per cent. When one thinks of the vast areas of farming lands in a state of profitable production, twenty-three years ago which must have greatly increased in value, then of the immense number of new farms apropriated and improved during that twenty years, the value of each having increased from nothing to in some cases many thousands of dollars, one naturally wonders that the increase in farm valuations have not left all others far in the rear and asks the question, "Why is it, is it due to a lack of intelligence?"

While they may lack that intelligence which enables the professional politician to go before a typical audience and with humor, oratory and ridicule delude it into the belief that it is listening to profound argument; or the lawyer who in the same manner beguiles jurymen into violating their oaths; or the financier who piles up his millions at the expense of credulous people; these things require qualifications along special lines and those who possess them to a high degree may not have average intelligence in any other respect, in fact they are very apt to be lacking in that intelligence which tends to good citizenship. If one takes into consideration the many and varied qualifications that

are necessary in order to secure even moderate success upon a farm he cannot attribute the reason to a lack of general all around intelligence. The reason must lie in the want of a unity of purpose. The occupation of a farmer is that of ministering to humanity's first and greatest need—something to eat—and that must be supplied at any cost. If farmers could be made to appreciate the two facts just stated, demand all that is justly due them and place themselves in a position by organization to enforce their demands they would soon be not the world's-drudges at the bottom round of the industrial ladder as at present, but at the very top round, the envy of all the rest of the industrial world.

THE RELATION OF BIRDS TO AGRICULTURE.

By Morton J. Elrod, University of Montana.

Bird protection may be studied from two standpoints, the sentimental and the economical. We have little to do with the former in this discussion, although there is much to be said. To discuss the use of birds as human ornaments is a subject by itself. The small boy, and sometimes the larger one, comes in for his share of censure. The birds have a right to live, so long as they are not a menace to human beings, and their rights are respected by fair and thoughtful people.

But we are to discuss birds from the economical standpoint, in dollars and cents. This may for convenience be divided into four heads: 1. Birds as food for man; 2. Birds as protection from insect ravages; 3. Birds as destroyers of weed seeds; 4. Birds as destroyers of noxious birds and mammals. Later we shall take up some of the few birds that do injury to man by destroying his crops, his fruit, his orchards, or his poultry. All of these are overestimated when the facts are considered.

I believe it is Prof. Forbes who says: "It is hard to balance the good things one reads about an animal by the the bad things he sees." The few observations made by the average person weigh heavier than all his reading. He sees a bird destroy a chicken, or eat some cherries, or pick up some grain, and immediately comes to the conclusion that the bird is destructive to his interests and should be killed. The scientific method of gathering all the facts obtainable and making a careful examination before coming to a conclusion is the theme of my brief discourse.

Each species of plant and animal has a tendency to spread. It is provided with some means for distribution. If left unchecked, and without enemies, it will, under favorable circumstances, cover the entire earth. Many species of both plants and animals have a very wide distribution, and the territory covered by them is constantly becoming wider. This tendency to migrate has given to different localities their present faunas and floras. To make a study of geographical distribution of plants

is an absorbing theme, and one that has been of great service to the naturalist as well as the farmer and fruit grower.

To elaborate the idea advanced a few illustrations may be made. Let us first take the English Sparrow. This is the common sparrow of England, which at home is not a nuisance nor a disturbing element. It was introduced into America in 1850 at Brooklyn. The first introduction was a failure. Later, in 1853, it was again introduced, a large lot being liberated in Greenwood Cemetery, New York. Successive importations were made during the next twenty years. It has no enemies, and found an abundance of food in the city. From that introduction the species has spread until at the present time it has covered almost the entire United States. It has been persecuted, bounties have been laid by legislatures, war has waged against it on every side, and still it thrives. At the present time it is even in the mountain state of Montana. From the east it has come by the railways, those great high-ways of commerce, as far as Great Falls. At Culbertson it is abundant, less so at each town westward, until at Great Falls a small colony became a fixture less than two years ago. By the Northern Pacific it has come from the east along most of the road in Montana. From the south it has come to Butte, Anaconda and Helena. It has not reached Missoula, but will no doubt be seen there before long. I well remember how a few years ago, I think it was in 1899, the late C. A. Wiley, of Miles City, bemoaned its arrival that year in Miles City.

Another illustration is the Gypsy moth. Some years ago an eastern entomologist received some eggs of this moth from England, for the purpose of experimentation. The eggs came in a paper, which was opened in the study. A gust of wind scattered the eggs, most of which were gathered up. Twenty years afterward there was an outbreak of the moth. The state of Massachusetts has spent nearly two millions of dollars in attempts to hold the pest in check, and it will take millions yet before they are through with it.

Then we may note the San Jose scale. This was first discovered near San Jose, California, in 1880. Hence its name. Until recently its nativity was not known. It is now believed to have come from China. This scale attacks the bark and stem of young trees, covers the twigs, leaves, and even the fruit, in such great numbers that the tree may be destroyed. It is one

of the worst pests for the orchard. It was next seen along the Atlantic coast, and has spread over the entire United States. At present it is not in the orchards of the State, although it has been taken on fruit shipped into the state.

We might mention the Russian thistle in America, the introduction of the mongoose into Jamaica for the purpose of destroying the mice in the cane fields, and dozens of other illustrations. But it would require too much time, although it would make interesting reading.

Of all the progeny of plants or animals but few survive. An adult lobster may deposit a hundred thousand eggs. Yet no more than a score are likely to reach maturity. The eggs of a tape worm stand one chance in a million of reaching a suitable place for development. If a single bacterium should be permitted to multiply and the progeny supplied with food and moisture suitable for development more than seventeen millions would be in existence by the end of twenty-four hours. If a single paramecium, one of the low one celled animals, should be given food and warmth for the uninterrupted development of the offspring resulting from fission the number resulting in thirty days would be 268,000,000. If the young of a single pair of robins should be permitted to live and multiply the number of robins in ten years from this pair would be very great.

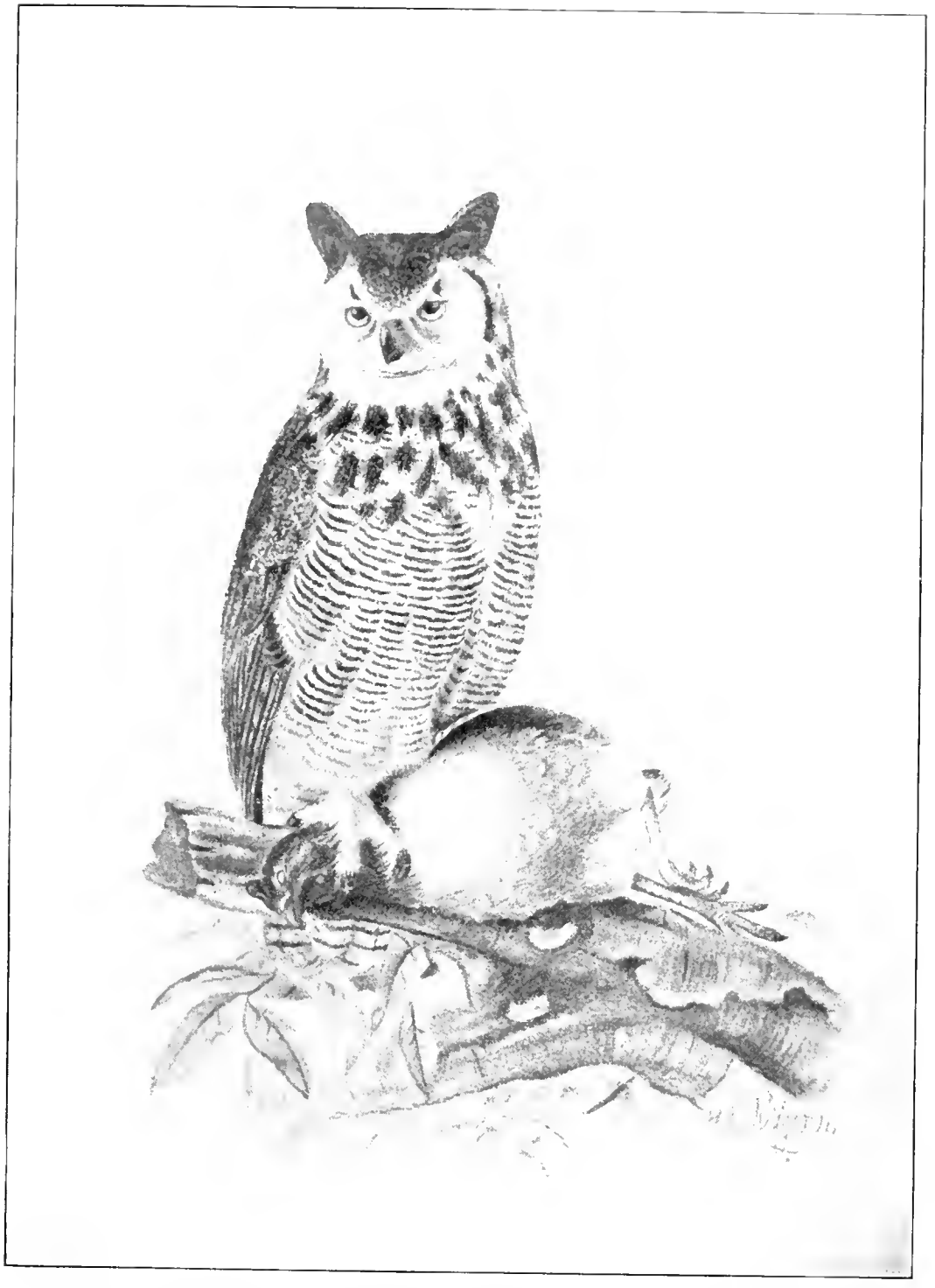
But nature seems malevolent. Of all the great number that is possible but few develop. There is a constant thinning out of numbers by enemies, climatic conditions, lack of food, and so on. The fittest survive. It is give and take. Some cannot endure the struggle, and die off. Some have little struggle, and become very abundant. But Nature has a tendency to strike a balance at last. The time usually comes when numbers are of no avail, and by their very numbers the race is imperiled. The mongoose was finally held in check by the tick. The little lady bird beetle bids fair to hold in check the San Jose scale. Bacteria are usually held in check by the living cells of the body. Few species of plants or animals overrun the earth, although the tendency is to do so. But the time necessary to find a remedy for an evil such as has been mentioned is sometimes very great.

Man is quite likely, through ignorance, to overturn the balance wheel of nature, so to speak, and send the whole machinery to smash. This is the case in the introduction of species of animals and plants to a new locality, where the conditions are new, and

where enemies are lacking. It therefore behooves us to look carefully into the question of what the result will be if the birds are killed off in large numbers, for the statistics show that they are going very fast. The study of game birds will have little to do with this question as it is presented to us as stated, from the fact that game birds are very few, and with the advent of man must disappear. It is to be regretted, but it must be so. The only thing we can do is to use our best efforts to keep them as long as we can, and possibly preserve from year to year a few remnants of a fast disappearing group of birds. The grouse family is the great family of game birds. In some places the turtle dove is shot for food, and in others meadow larks, bobolinks or rice birds, are killed. Our present laws are inadequate for the protection of these birds. A man may kill twenty of each species each day during the season. For ducks there is no limit as to the number killed. Since the last game law has been declared unconstitutional there is no protection for ducks from the first of September to the first of May.

The methods employed to determine whether birds are useful or harmful as insect destroyers or as seed gatherers, will be of interest to some. The fate of a bird is a very important item. If it is charged with crimes which it does not commit we cannot excuse ourselves for the crime of killing it off. To kill off a bird without trying it fairly is not in accord with the spirit of fair play that is so prominent in all the actions of the American people. How shall we determine whether or not a bird is our friend or our enemy?

The United States Department of Agriculture is doing much work in this direction, and the results so far are of far reaching importance. The study necessarily involves the killing of a large number of birds. But this killing is justified, for by their loss thousands will probably be saved through the study of the birds slain. The birds of a given species are taken at all seasons when they are to be had, in all parts of the country. It is not fair to take them at the time they are supposed to be doing damage and at no other. The good must be balanced against the evil. Perhaps hundreds of birds will thus be killed in different parts of the country. The stomach of each is removed and preserved. Later the contents are examined by specialists. It is not a very pleasant occupation to examine the contents of hundreds of birds, working over pieces of ants, wings of beetles, parts of spiders,



Great-horned Owl, **Bubo virginianus** Gmel. From Biological Survey.

American Goshawk. **Accipiter atricapillus** Wilson. From Biological Survey.

half digested grain, portions of fruit, and the like. But this must be done. It requires no small amount of information on the part of the examiner to do this intelligently, and the work is necessarily slow and expensive. The different things found in the stomachs are then arranged and tabulated, including everything that can be determined, whether beneficial or injurious to man. This is then figured in per cent of the different ingredients. By this means the food of the bird for the season is determined. Also, if there is a difference in different localities it is determined. The results are published, and are available on the part of any one interested so long as they may last. All that is necessary is for the person interested to address a letter to the Secretary of Agriculture, Division of Biological Survey, Washington, D. C., and ask for literature relative to beneficial and injurious birds. In this manner many birds have already been studied. To give a summary of the work would be unnecessarily tedious, and would be useless since it is available in printed form. Appended to this paper will be found a list of papers, many of which are yet obtainable, which relate to the subject.

Much of the information which I am able to present has been gathered from the sources previously mentioned. Indeed, if I were to claim originality in what I am able to give, I would be presumptuous. Let us find from the statistics of what importance the study is financially.

It is estimated that $200,000,000.00 are lost annually to the farmers and fruit growers of the United States through the ravages of insects. This is one-tenth of our total agricultural crop. To lose one dollar in ten is a heavy toll to pay the insects. This toll is especially heavy from the fact that it usually falls on some section or sections of the country, when the crop for over a large tract may be completely destroyed. The number of birds in species in the entire North America, according to Ridgway, is about 800. There are over one hundred thousand species of insects, and most of them are injurious. The injuries come from the young or larval insect, either through destruction of the foliage as food, or by sucking the life out of the plant with the beak, or by penetrating to the interior of the leaf or stem, there eating the vital part of the plant as food or making a cavity for the deposition of eggs.

An examination of the statistics show that birds are great destroyers of weed seeds. Most weeds produce seeds in great

abundance. If this were not so the species would soon become extinct. I have watched the grosbeaks every winter eating the seeds from the box-elder trees in my yard. I have watched the cedar waxwings strain their little necks to reach the wild rose apples. What a beautiful sight it is to see the male, with his dash of brilliant scarlet on the wing, craning his neck for a rose apple scarcely less beautiful, the bush swaying back and forth with the weight of the bird, which must use both legs and wings to keep position. I have watched the horned larks as they sought the apparently barren plain in search of food, sometimes going in flocks of hundreds. I have killed the Rocky mountain jay when his cheeks were crammed with nuts from the yellow pine, which he was evidently storing for food. Who has not seen the little sparrows on the almost barren ground searching for food. During the migration period the university campus at Missoula is alive with sparrows, quietly searching the weeds for a meal. Prof. Beall has estimated that the tree sparrow alone in the United States destroys annually 1,720,000 pounds of seeds of noxious weeds. Every person should recognize the sparrows. They are small, usually of a gray or slate color, with short and thick bills. The bills are specially adapted to cracking seeds. These birds are very useful, and should by all means be preserved. They are friends to the farmer and fruit-grower, and should receive his protection.

Birds are the natural enemies of insects. In the woods one may find the little warblers, a large and interesting family of birds. These are built on a different plant from the Fringillidae, or seed eaters. The Mniotilidae, or warblers, are small and trim little fellows, often with bright and even gaudy colors. Their bills are small and slender, specially adapted for piercing the body of an insect larva. These birds may easily be recognized, and are as useful as Fringillidae or finches, but in another way. They are largely migrants, spending the summer with us, when the young are reared. The winter months are spent farther south, whither they go about the first of October. Some go much earlier. During their stay with us they are engaged in the daily occupation of gathering food and rearing their young. The food consists largely of insects, which they seem to search constantly. These birds no doubt destroy insects which, without the birds, would perhaps destroy much vegetation. Since it is estimated that on the average each bird in the country de-

stroys as many as 2,400 insects one cannot even speculate as to the number of insects destroyed.

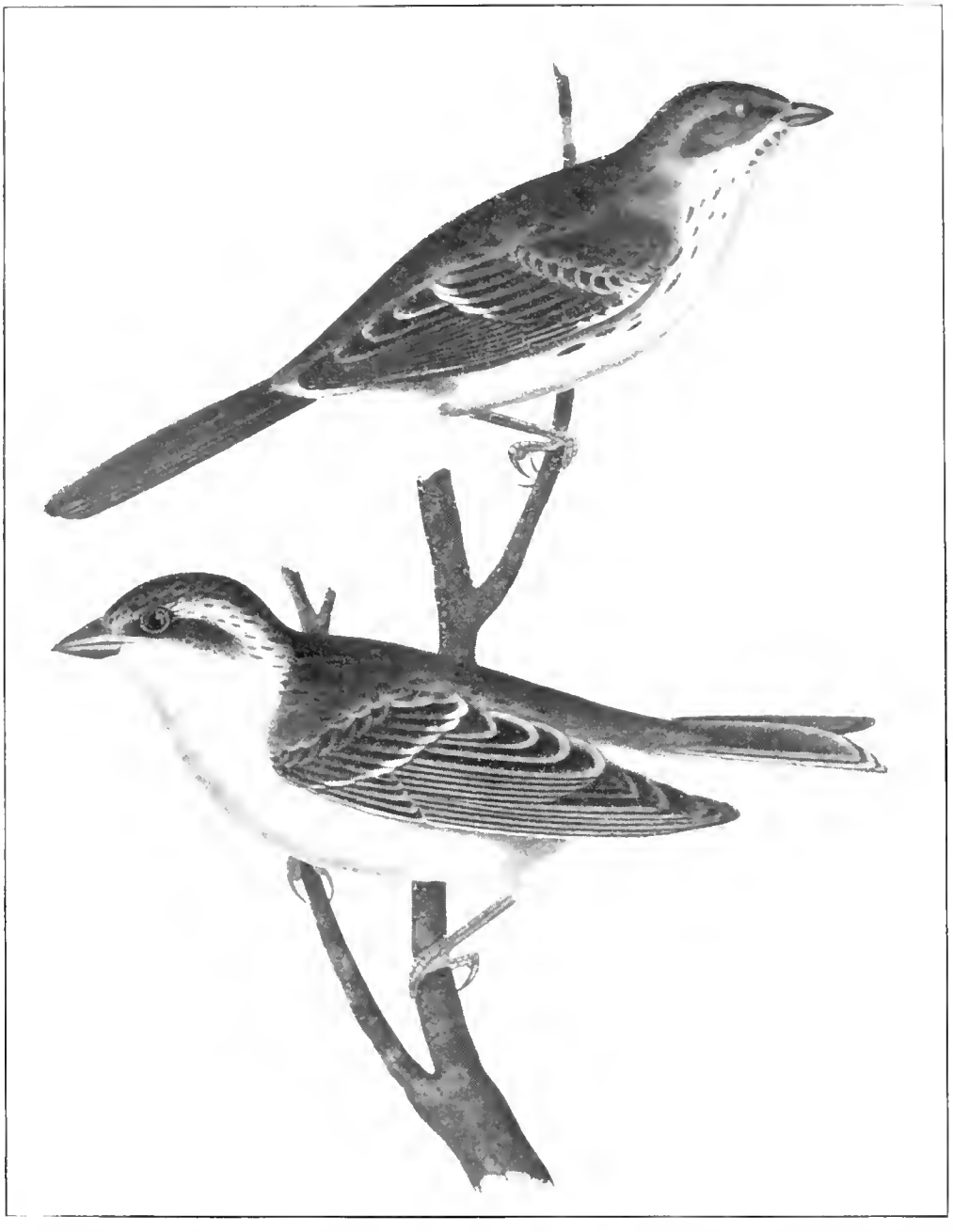
Statistics relative to the increase or decrease of birds in the United States are scarce and hard to secure. A few years ago G. O. Shields, editor of Recreation, secured opinions from hundreds of persons all over the United States relative to the number of birds at that time compared with ten years previous. The result was astounding. The opinion prevailed that the number of birds in a given section of the country had greatly decreased during the decade. In many cases the decrease was as much as fifty per cent. While the statistics are only opinions based on observations by careful observers, it is safe to assume that birds in the greater portion of the country are on the decrease, and that very rapidly. This is greatly to be deplored, for with the decrease has come a great increase in insects, which have wrought great destruction. What are the causes for the killing of useful birds?

First may be mentioned the elements. Severe winters often destroy birds in great numbers, especially when they migrate early and are then overtaken by severe storms, when food cannot be obtained. But the elements are insufficient to account for the great mortality. Their natural enemies kill a large number. These enemies are snakes, birds of prey, weasels and other mammals. Then comes the domestic cat. In thickly populated districts the cat is abundant. It is a great destroyer of birds, and if statistics could be secured it would be responsible for a very large number of birds. There can be no question but that the cat is a menace in many localities, and should be killed in large numbers. In cities the cat, the English sparrow, and the boy, have driven the birds practically from the region. Then comes the great enemy of the birds, often unintentional and without giving thought, man. The desire to kill is inborn in the human breast. It is an instinct borne of a distant past, when might was right. A boy or a man with a gun must shoot something. A stone on a fence post is not half so tempting for a shot as a woodpecker or a meadow lark. The unsuccessful attempt to bring in a rabbit, a quail or a pheasant is likely to result in the destruction of a few birds, just to bring down something. The small boy with fire arms does untold destruction to bird life. The pump gun has almost destroyed the grouse and duck, and if the automatic gun is not squelched before it is put

on the market the last of the feathered tribe is not very far distant in time. Then woe to the farmer and horticulturist. Laws are not sufficient to stop the destruction. Public sentiment must be aroused to the great value of our feathered friends, and the wanton destruction that so often prevails. In the eastern and middle states severe laws are now in force. In some cases these stringent laws came late—too late to be of best help in saving the birds. But even with stringent laws the mortality continues and the decrease becomes greater with each decade.

From the best information obtainable it appears that birds are on the increase in this state. This is to be expected. The state is large and the inhabitants comparatively few. Large tracts of land have been put under water through irrigation, thus making food more abundant and making it possible for a greater number of birds to live than formerly, and also providing food for different species than is the case when the land is in its natural state. All the old timers who have been close observers seem to think that birds are more plentiful than formerly. There is still much land in the state to be brought under cultivation. Large irrigation schemes are under construction both by the government and by private individuals. Hundreds of thousands of acres now growing but a small amount of grass will in the next one or two decades be producing crops, and furnishing homes and food for thousands of people. With this influx of people and accompanying this large acreage of farming must come the countless hordes of insects that will find food and home. They will surely come, and we may as well make way for them and prepare for them. At the same time we may expect a large addition to our avifauna. With the disturbance of the balance of nature on so large a scale no one can predict which will be the greater in relative numbers. It is reasonable to suppose that the insects will be the first to arrive, and that the birds will be slower. We have the birds. They seem to be on the increase with us. We can do much to aid in their propagation by making the conditions favorable. How can this be done?

First, by executing the laws of the state, and enforcing them on those who kill birds contrary to law. The game warden will furnish copies of the laws to all who may make inquiry, so there is no need of pleading ignorance. Second, by developing a healthy moral sentiment among the people, and especially among the youth in the public schools. This may be done by example,



Types of finches, or seed eating birds. The upper the desert song sparrow, **Mellospiza fasciata fallax** (Baird). The lower is Cassin's purple finch, Carpodacus cassini Baird. From U. P. R. R. Survey.

Meadow Lark, Sturnella magna. From Ornithology of Illinois. The western lark is Sturnella magna, var. neglecta.

by good literature, and by giving information relative to the habits of birds. No thinking person can study birds without having increased love and sympathy for them. Third, by providing suitable places for them to use as nesting sites in which to build and rear their young. This may seem of little avail where the country is so vast and the population so scanty, but if each one does his best the result must be to help in the increase. In a recent trip of several hundred miles but one bird box was observed, and that was placed by a small boy. We need more such boys, and more such nesting places. The flycatchers must seek the commutators on electric light poles, or the eaves of houses, when they should have nice boxes, free from interruption and safe from the cat.

The work of the farmer and the fruit grower in the state is but in its infancy. Nearly a quarter of million fruit trees were planted in the state during the past year. When all the orchards in the state shall be bearing what a harvest it will be. In all portions of the state increased acreage is made in wheat, meadow, alfalfa, barley, and other grains and grasses. We have the experience of the past and of the eastern states for our heritage. We have the birds, and we know their value. If we do not take advantage of the conditions the fault must lie with us.

What is the number of birds in the state in species? When we talk of the different species we mean what is generally referred to by the word **kind.** All the birds that are called by the name great horned owl are of one species. All the countless English Sparrows are included in but a single species, **Passer domesticus.** Observations have been made during the past five years on the birds in the region about Flathead lake. This is a good field for the ornithologist in many respects, and the work accomplished by the University of Montana Biological Station is the first systematic study of the bird fauna of the state. The results obtained through the dilligent efforts of Prin. P. M. Silloway and others show but 137 species, including all species of summer residents, summer and winter residents, spring and fall migrants. This is not a large number, and many of them have but a few scattered specimens. In the bulletin "Birds of Fergus County," by P. M. Silloway, recently issued by the school board of the Fergus County Free High School, 175 species are listed. Fergus county is about as large as the state of Massachusetts, and is in the great Missouri river highway, up

which so many birds and animals have come from the Mississippi river and the Great Plains. Miles City shows a list about as large as that from Fergus County. The entire avifauna of the state will no doubt be much less than most people expect, and certainly will not exceed a few hundred. Of this number what proportion are injurious?

We may now hastily examine the records relative to few birds, some of which are on the doubtful list, others clearly proven to be injurious, and deserving of no protection.

Grave charges have been made against the robin. In some localities he is persecuted during the cherry season. No charge seems to be made against him at other times. Let us examine the charges, and see if they are well founded. The robin is one of the earliest harbingers of spring. He is known to all, and his cheerful song in the early morning or late evening as he takes his position on the cupola of a building or on the topmost bough of a tree has been the theme of poets for years. After their arrival in spring they often roost in large numbers in some locality. They have been known to go a hundred miles for breakfast ,and arrive at the feeding ground shortly after sun up. In the evening they return to the roost, a hundred miles on the return. Thousands will congregate in these roosts. Later they pair off and the pairs seek some suitable place in which to build a nest and rear the young. They are principally ground feeders, as may be recognized by their long and stout bills, although they have bills much smaller than the orioles, which are typically ground feeders. The food of hte robin consists of larval insects, worms, beetles, occasional mollusks, spiders, insect eggs, and fruit, both wild and tame. Prof. Forbes says: "I do not believe that the horticulturist can sell his small fruits anywhere in the ordinary market of the world at so high a price as to the robin, provided that he uses proper diligence that the little huckster does not overreach him in the bargain. In other words, while the bird is far too valuable to exterminate, at least until we are sure we can replace him by some cheaper assistant, yet he is not so precious that we need hesitate to protect our fruits from outrageous injury. Indeed it seems likely that the ordinary destruction of robins by gardeners does not more than compensate for the destruction of birds of prey in the interests of the poultry yard--removing that

excess of robins which, in the more natural order, would fall victims to the hawks and owls."

Mr. W. F. King, in Vol. I of the Wisconsin Geological Survey says of the robin: "In its method of obtaining food and in the situation from which its food is gleaned, the robin performs a very important work, and one for which few other birds are so well adapted. So important is this work that the quantity of small fruit which it consumes is but a stingy compensation for the service which it renders, and I know of no bird whose greater abundance is likely to prove of more service to the country." He examined thirty-seven stomachs.

Dr. E. V. Wilcox examined 187 stomachs in Illinois. He says in his summary, "the fruit-grower should at least be allowed to kill the robin during the season when he is most harmful, and not, as at present, be in danger of arrest and fines for shooting the robins in his own garden.'

Educational leaflet No. 4, referred to in the bibliography, says concerning the robin; "That the robin is a very beneficial bird there is no doubt, although it is claimed by some persons, especially small fruit growers, that it eats cultivated fruit to an injurious extent. This charge, the evidence shows, is confined to special localities and to a very limited period and is not all general. The horticulturist can protect his small fruit crops by growing a few wild fruits for the robins and the cultivated kinds will not be disturbed; but thousands of injurious insects will be eaten that would otherwise be a pest. A careful study of the food tables abstracted from data furnished by the Bioligcal Survey, United States Department of Agriculture, ought surely to convince everyone that the robin is a very valuable aid to the agriculturist and therefore ought to be carefully protected."

Statistics compiled show that for the entire year the food of the robin was as follows: insects, sixty-five per cent, cultivated fruits, twenty-five per cent, wild fruits, ten per cent. Of the insects about forty-five per cent are injurious, thirty-five beneficial, the remainder neutral. There are no statistics on the bird from Montana. Until we make a study of it we may well hold judgment in abeyance, since our wild fruits are so abundant and so luscious for birds.

The meadow lark is with us the first harbinger of spring. In most states the bluebird and the robin are first looked for in the days when winter is fast disappearing, but in western Mon-

tana the call of the meadow lark as he sits on the top of a telephone pole or perches on a rock or fence is the first indication that warmer days are coming. The meadow lark is an interesting bird. It sings from the time it first comes in spring until it disappears in the fall. It has as many as eight different notes, and seems to take delight in alternating them while making its repertoire of music.

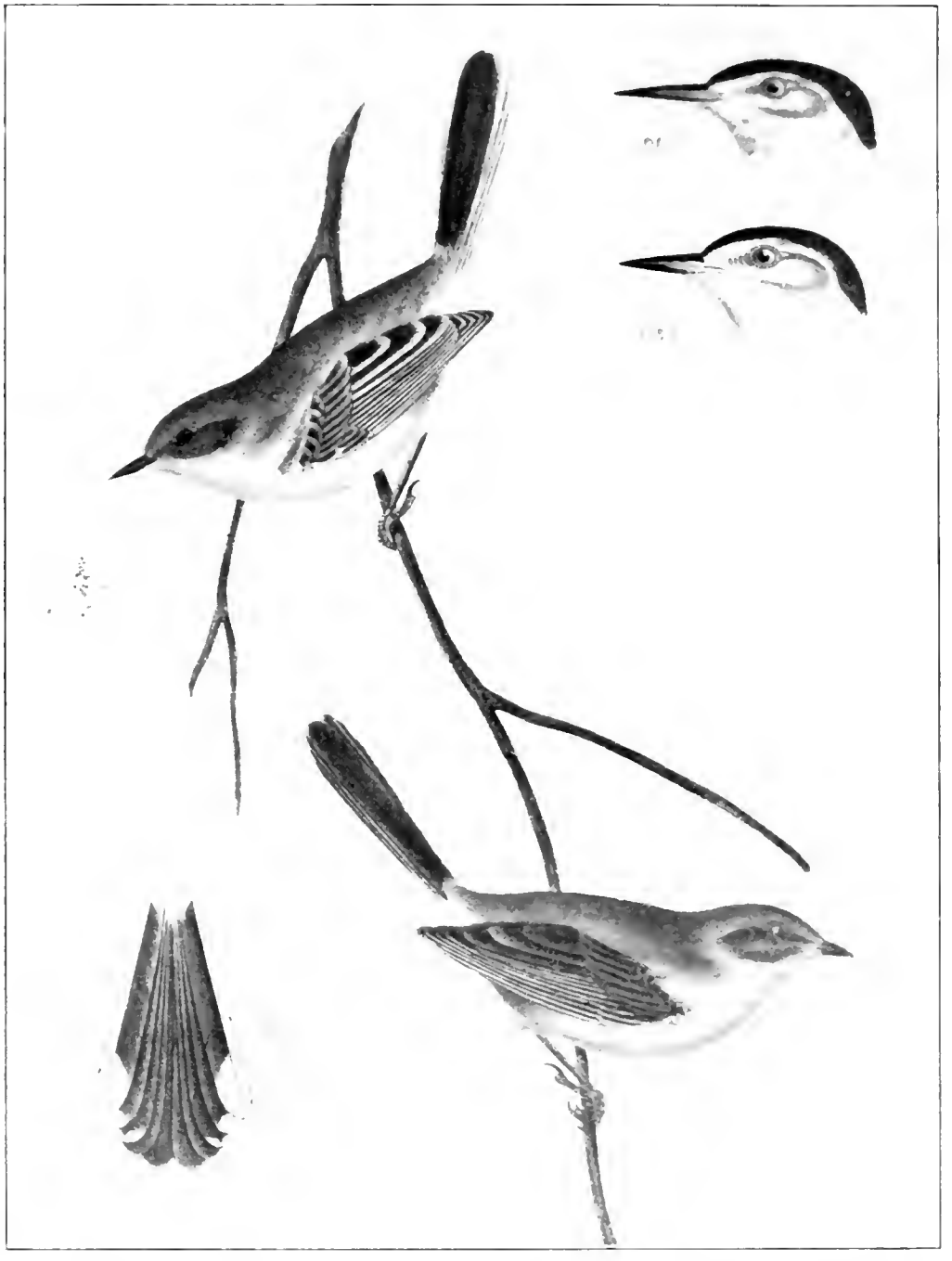
The meadow lark belongs to the oriole family. Its near relatives are the blackbirds and orioles. All of the family are ground feeders. They are provided with long and strong bills, fitted for digging in the ground, and for pulling worms out of the earth. The meadow lark nests on the ground, seeking some clump of bushes on the dry prairie, and there rears its young. It searches the vicinity for food for the infant larks. In meadows where the ground is under cultivation its habits are the same as in wild nature, save that it adapts itself to new conditions.

The meadow lark is one of the most useful of birds. From the fact that this is not generally appreciated it seems fitting that some little time be devoted to making a few statements in regard to its usefulness to man.

Practically nothing is to be said against the bird, and much in its favor. It is a great insect destroyer. Its choice food when it is to be had is the grasshopper. The bird is probably without a peer as an insect destroyer. It is a bird of good size, and hence requires a large amount of food, and is a diligent collector. An interesting article on the meadow lark by Prof. Beal is to be found in the Yearbook of the Department of Agriculture for 1895. In this Prof. Beal gives the following calculation in regard to its usefulness. "Remains of as many as 54 grasshoppers have been found in a single meadow lark's stomach but this is much above the average number usually eaten at one time. Such food, however, is digested rapidly, and it is safe to assume that at least 50 grasshoppers are eaten each day. If the number of birds breeding in one square mile of meadow land is estimated at five pairs, and the number of young that reach maturity at only two for each pair, or 10 in all, there will be 20 birds on a square mile during the grasshopper season. On this basis, the birds would destroy 30,000 grasshoppers in one month. Assuming that each grasshopper, if let alone, would have lived thirty days, the thousand grasshoppers eaten by the larks each day represent a saving of 2.2 pounds of forage,

Yellow-bellied Sapsucker.
1, 2. Male and Female; 3. Young.

Yellow-bellied Sapsucker, Red-naped Sapsucker, **Spyrapicus varius.**
From Birds of Pennsylvania. The western bird is var. **nuchalis.**



The lead-colored bush-tit, **Psaltriparus** plumbeus Baird, shown by the two birds and the figure of tail feathers. The upper heads are nut-hatches. These are insect eating birds, as may be seen by the long sharp bills. From U. P. R. R. Survey.

or 66 pounds in all for the month. If the value of this forage is estimated at $10.00 per ton which is below the average price of hay in the eastern markets, the value of the crop saved by meadow larks on a township of 36 square miles each month during the grasshopper season would be about $24.00."

More than half of the food of the meadow lark consists of harmful insects. Its vegetable food is composed of noxious weed seeds, waste grain, with some useful beetles, neutral insects and spiders. Although it is naturally an insect eater it can subsist on vegetable food if necessary, and as a consequence is not forced to migrate during cold weather any further than is necessary to secure food. In western Montana it not infrequently stays around barns during the winter, picking up refuse.

As stated before, the meadow lark is in some places considered a food bird. In Montana it is classed with the song birds, and permanently protected. It is entitled to all possible protection, and to slaughter it for game is a poor way to utilize so useful a bird.

It is impossible in the short space assigned to me to speak of many birds. There is one bird, however, that is harmful to the orchardist, which must not be overlooked. I refer to the rednaped sapsucker, **Sphyrapicus varius nuchalis** Baird. They do damage to trees by drilling holes in the bark of apple, thornapple and mountain ash trees, sometimes encircling the trees with these holes for a distance of two feet. They drink the sap of the apple tree, and in some cases kill the tree. Insects collect about the punctures of the tree thus made, and the bird later returns and makes a feast from the insects. The number of trees killed by this bird is not great, and large numbers of the insects which it destroys are harmful. It is therefore an open question as yet whether the bird should be killed for its attack on the trees or let live. The damage reported in the state is slight.

Lewis's woodpecker is the black bird, with a reddish breast and flight like a crow. It is a very abundant bird in the wooded portion of the western part of the state. It has been reported as doing damage to orchardists by pecking the apples while yet they hang to the tree, and thus making them unsalable. The amount of damage is not great, and it is rather surprising that this bird should take to eating fruit. As all the woodpeckers

are insect eaters orchardists should be very slow to kill the birds because of a little damage. The damage from a few insects is too well known to need argument. If it is a choice between two evils the lesser is likely to be chosen. The orchardist should examine the conditions carefully and decide for himself. If the damage is great he should have the privilege of protecting his fruit. If it is small, he should be slow to kill.

Much damage is attributed to the hawks and owls, which are quite plentiful, especially in the wooded section. How much of the popular belief in hawk and owl mischief is true, and how much is false? The majority of the hawks and owls, as of other birds, are useful, and but a few are to be condemned. The popular belief that all hawks and owls should be shot on sight is not well founded. The damage done by hawks and owls is by carrying off poultry, small lambs and pigs. Some of them are very destructive to small birds which latter may be very useful. At least one species is hard on the grouse family, killing large numbers of game birds. Their benefit comes from their carnivorous habits. Instead of preying on poultry most of the species live on mice, gophers, ground squirrels, moles, and even insects. The little red hawk that is so abundant along the roads in the summer, hanging in mid-air at times, again roosting on a post or rock, is a great enemy to the grasshopper, killing them by the thousands. So great is its capacity for the grasshopper that it goes by the name of grasshopper sparrow. Early in the spring and late in the fall it is severe on small birds, but its benefit far outweighs the destruction caused in killing birds.

Our largest bird is the great horned owl. This well known bird is fierce and untamable, and in strength and courage is inferior to none of our rapacious birds. The food is of great variety. It catches birds and mammals, fishes, crustaceans, and insects. Among birds it takes poultry, including half-grown turkeys, grouse, quail, doves, and wild ducks. Hawks, crows, and other fowls do not escape this rapacious bird, and large hawks are among those attacked and eaten. Dr. Fisher remarks of the species: "In studying this owl in relation to its food it will be perceived at a glance that a bird so powerful and voracious may at times be a source of great benefit, while at other times it may be the cause of great damage. Now, the serious inroads it makes on the tenants of the poultry yard, as

well as the destruction of many game and song birds would seem to call for the total suppression of the species. Again, when engaged chiefly in the capture of injurious rodents, which threaten the very existence of the crops, it is the farmer's most valuable ally, and consequently should be most carefully protected." The rabbit stands at the head of the list of mammals most frequently eaten by this bird. It is said to be fond of spermophiles or ground-squirrels. It is reputed to be an expert rat catcher. It has been proven to eat mice and shrews, muskrats, woodchucks, and opossums. On one occasion a porcupine was attacked.

The bird inhabits wooded regions, where it finds both a home and an abundance of food. It is likely that in newly settled regions the bird may prove harmful, but as it disappears with the advance of agriculture its damage will not be for long.

Three birds may be mentioned which have brought the hawks and owls into disfavor. The sharp-shinned hawk, **Accipiter velox,** Cooper's hawk, **Accipiter cooperi,** and the goshawk, **Accipiter atricapillus.** The first two are much alike except in size. The illustrations accompanying will give a fair idea of the species, although it is to be regretted they are not in colors. Velox is an impudent and daring little bird from 10 to 14 inches in length, and little can be said in its favor. Its food is poultry and young birds, with occasional rodents. **Cooperi** is similar in appearance but larger, being from 14 to 20 inches long. It is much more to be dreaded than the preceding, as it is larger and stronger. Its food is about the same as that of **velox,** but it is a great enemy of the domestic pigeon, and will stay by a flock until it cleans them out or meets a tragic death. It is very fond of meadow larks, robins and flickers. One benefit derived from these two is that they have found the English sparrow a toothsome morsel, and easily obtainable, and have created great havoc among these birds in the eastern states. The goshawk is still larger than either of the two just mentioned, being 21 to 25 inches in length. It is bluish slate color above, top of head deep black, tail crossed by four dusky bands, white below, thickly barred with narrow zigzag lines of grey, feathers often streaked in the middle with dusky color. With us it is found usually only in the fall and winter, moving to the northern regions in the spring. It is especially bad on the grouse family, and is very destructive to poultry. It is the

most daring of all birds, and many almost incredible stories are told relative to its boldness and daring. It will dart down at the feet of a farmer after a fowl, and even followed one into a house, where it was despatched with a stick.

The flight of the three species, as well as their general habits, may be readily studied by watching any one of them. They fly much alike, with great speed, and with accuracy. They are trim birds, with very sharp claws, and on account of their trim carriage, swift flight, boldness and daring, are easily recognized. They should be shot on sight. But it is well to make no mistake in the decision, for the other birds except those mentioned are very useful.

The study of the birds will prove of both interest and profit to those who may be persuaded to find out more relative to our feathered friends. The literature suggested will be both interesting and profitable to the farmer and fruit-grower. At a comparatively small expense manuals may be secured which will enable the student to identify species. The subject is a big one, and full of interest and importance. It is but touched in this hasty sketch. Some of the literature suggested should be secured and read.

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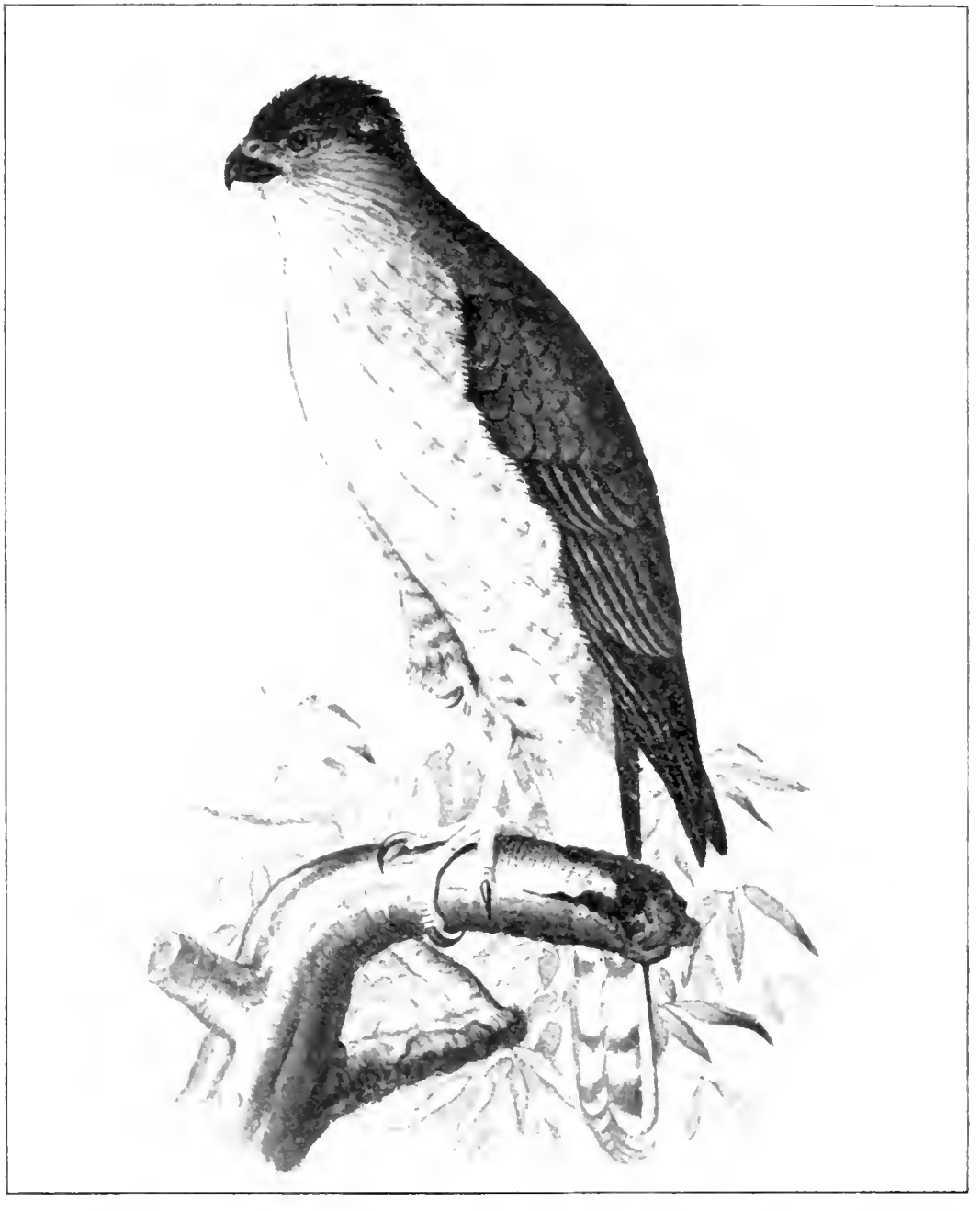

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Summer Birds of Flathead Lake, by Perley Milton Silloway. Bul. Univ. of Mont., Biol. Series No. 1, 84 pp., plates IV-XVI. Univ. of Mont., Missoula.

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Additional notes to Summer Birds of Flathead Lake, with special reference to Swan Lake, by Perley Milton Silloway. Bul. Univ. of Mont., Biol. Series No. 6, pp. 289-308, plates LIII-LVII. Univ. of Mont., Missoula.

TRANSPORTATION AND MARKETING OF FARM PRODUCTS.

By W. M. Wooldridge, Hinsdale.

Frequently we hear those engaged in various branches of agriculture complain about their inability to find a profitable market for such products on account of the transportation lines refusing to make proper rates.

Many times I have heard such complaints made throughout Montana and upon investigation I find no grounds for complaint and the difficulty to be with the farmers themselves.

James J. Hill, President of the Great Northern Railway, was the first man who solved the problem of transportation, and on his line a load must be found for his cars both ways. He has determined the exact cost per ton per mile to transport freight. The first point to be considered is the problem of getting the car back to the starting point. If a load is assured both ways, the rate is much less than if freight is only transported one way and the car returned empty.

The second consideration is the volume of the business furnished. A rate can be made much less on a 20-car shipment than for a single car shipment; much less on a 200-car shipment than for a 20-car shipment.

The Great Northern Railroad has frequently met the wishes of the farmers living along its line in northern Montana, by making such rates as will enable them to market their surplus products. It has often occurred that this rate has been one much below a figure that would represent a profit to the Railroad. I might cite an instance, a rate of $3 per ton on baled hay from Chinook to Helena, a distance of 243 miles, or a rate of $3.50 per ton on the same from Malta to Butte, a distance of 345 miles. When it is considered that it requires a pretty good sized car to contain 10 tons of baled hay, making the rate $30 and $35 to these two points respectively, it will be seen that there is very little money in it for the railroad company. The question naturally arises; why do they do it? Mr. George O. Somers, Gen-

eral Freight Agent of that line has often told me that such rates are made solely for the purpose of getting the surplus farm products out of the country in which they are grown, and to enable the farmer to realize something for his efforts. Repeatedly he has urged our farmers to feed this same grain upon their own land, citing as a fact, that there would be more money in it for the farmers and the railroad if they feed.

The difficulty on both the Northern Pacific and Great Northern in the matter of transportation and rates, is the one to secure a west-bound shipment. There is no difficulty whatever in securing an east-bound shipment from the coast points. Recently when in Helena, I heard the complaint made that a very low rate had been made from Milk River points on Milk River Valley products, to Spokane and Seattle, and at less rate proportionately than upon lumber from the Flathead to Milk River points. It was not generally understood that many empty cars had to be transported west to Seattle and to obtain a load, even a part of the distance at a very low rate, was preferable to hauling empty cars at a loss.

I believe Mr. Hill has figured out the cost of transporting an empty car from Minneapolis to Seattle to be something in the neighborhood of $8 per ton. It will be seen that on a ordinary car weighing 12 ton, the actual cost of hauling that car would be $96.80. If a part of this cost can be met by obtaining a few additional tons and realizing a revenue from it, it will help considerably in meeting the cost of hauling the empty car.

While attending the mid-winter horticulture meeting at Stevensville last February, the question of rates came up. Some members advocated very radical action to endeavor to secure a rate that would enable them to market their surplus products. After considerable discussion, it was decided to appoint a committee to see if an understanding could not be reached between the Great Northern and Northern Pacific lines. I am pleased to report that this has already been undertaken and the transportation lines have replied very encouragingly. The difficulty which naturally arises in taking a car, say from the Bitter Root Valley to Northern Montana would be the question of getting that car back to the Bitter Root Valley. There would hardly be any probability of a load being furnished on the return trip, the actual cost of moving that car would have to be met, and in this case this cost would have to be added to the cost of moving

the original shipment. I refer to the Bitter Root Valley and Northern Montana particularly, for the reason that this is the market which seems to be sought by our Bitter Root friend. It has been stated by our Montana friends that a satisfactory rate could not be made between these points and eastern Montana points for the reason that two local rates would have to be applied on both lines. I do not believe it to be so much a question of local rates as this question of returning the cars empty.

It can be stated without any fear of contradiction that the people who are most vitally concerned in the welfare and upbuilding of this state, are those people who are interested in transportation within the state. The upbuilding and development of the state is the very life of these transportation companies, and when a matter has been presented to them properly, there is no question but what they will be only too glad to make such rates as will encourage the farmers, stockmen and fruit growers, now located or who may locate with Montana.

It is a well recognized fact among railroad men that it is the local traffic that pays the best; not necessarily in a direct way. A road operating within a certain section of the country may not realize a profit in transporting the products produced within that particular section of the country, but they will realize a profit on the other industries of the people and in the building-up and development of a heavier traffic.

With the exception of possibly the fruit industry, wool, beef and mutton industry, it can hardly be said that any traffic has been developed within the state as yet. I have often heard farmers complain about their inability to find a market for potatoes and, when the situation was canvassed, I found less than a carload could be made up. This reminds me of an amusing incident which occurred in Butte recently. A business man of Bozeman interviewed one of the largest merchants in Butte in regard to finding a market for eggs. The Bozeman man made a special trip to Butte and interviewed the man in question. The merchant said: "Why certainly we can find a market for eggs. How many have you got?" The Bozeman friend answered: "Oh, possibly 15 or 20 cases a week." The Butte merchant informed him that he could use a straight carload of eggs every two weeks.

It is hoped that the Committee appointed by the Horticulture Society will be able to reach a definite understanding with the

transportation lines in the matter of rates on fruit in time for the fall shipment of Bitter Root fruit this year.

Looking at this matter from a broad standpoint and waiving the question of freight rates, we do not believe the best interests of the farmer of this state will be served by securing concessions from the roads that would enable them to market the bulk of the articles produced upon their farms. The best interests of the Montana farmer will be served by marketing such products in a concentrated form. Whenever I have visited the states of North Dakota and Minnesota and have seen a number of large elevators line up along the side tracks of the various stations, the thought has occurred to me, how much better and more profitable it would have been for those communities, if we could see an occasional creamery or more shipment of fat stock instead of depending so much upon one crop. The result of the development of the feeding of sheep and cattle in the Yellowstone Valley and in the vicinity of Billings is now well known throughout our state. We hear little or no complaint from those people in regard to their inability to find a profitable market for everything produced upon their farms. Incidentally we hear of vast sums being made from an acre of ground. We are frequently told that this man or that man has a large farm which is netting him 10 per cent on a $100 or even as high as a $200 valuation. This has been brought about entirely through the feeding of beef and mutton, and as a result, with the vast acreage that has been put into alfalfa and clover, all other farm products has advanced in price proportionately.

Within the last few years they have combined grain feeding with alfalfa and as a result they have a fixed market for every pound of grain which they can produce at not less than one dollar per 100 pounds. Most of the farmers in that region obtain that price upon their own farms without the necessity of hauling it to market.

They have made a practical study of stock feeding and they have made a very marked success of it. They are now giving considerable attention to dairying and pork production which promises to become equally as profitable. In five years their land has advanced from the value of about $20 per acre to $60 and $75. This is no fictitious value either. This land at such valuation will readily pay above 10 per cent as an investment. The people of the Gallatin Valley are likewise giving a great

deal of attention to these matters. Their land too has advanced fully as much as the Yellowstone land and within the past two years, the Milk River Valley people have followed in the footsteps of the Billings people, and the result is very encouraging indeed. In the latter valley where a few years ago the farmers sought to obtain an outside market for such hay, grain and vegetables as they produced, but now it is with considerable difficulty that our merchants can supply the demand from outside points for such produce, and at a considerable advanced price. This price, while not yet so high as in the Gallatin or Yellowstone Valley, is rapidly nearing that point, and when it is taken into consideration the vast acreage which we have under irrigation and the wonderful wealth of farm products which would result if agriculture was conducted along these lines, it will be seen that we too would likewise be begging for a market. Our people are known far and wide for the wonderfully fine financial condition. Banks are being established rapidly throughout the valley. Money is being invested freely, rate of interest is being lowered, we now being able to secure plenty of money at 8 per cent. Stock investments are much safer than a few years ago when all was chance, and I believe it is along these lines that the various valleys throughout the state seek to work rather than to ship their bulky articles out of the community.

The principal advantage of marketing the bulky farm crops in a concentrated form such as I have suggested, viz., beef, wool, mutton, pork, butter and eggs, is that we have practically no competition, especially is this true of the fattening of sheep and cattle and of pork growing. It is said that we can produce pork in this state at a cost of 2½ cents per pound. Personally I have never been able to do this well; the best that I have been able to do has cost me in the neighborhood of 4 cents, but Montana is scoured each winter by buyers from the Pacific coast who seek to purchase our fat beef and mutton, and it is only a question of a few years until this entire produce will be shipped westward instead of eastward.

In many sections of the state where alfalfa cannot be grown successfully, either red clover or alsike can be grown and feeding can be conducted as successfully with these crops as alfalfa, or nearly so, and I believe my friend, Prof. Linfield will say, at least one per cent per pound for grain can be realized by feeding it with such forage crops, and if the farmer is always sure of

a standing price of one cent per pound for all the grain that he can produce upon his farm, I don't think he has very much reason for complaint; especially is this so with our immense yields which we are able to secure by the aid of irrigation, and it is along this line that I would urge my farmer friend to solve the question of transportation, and when the proper time comes to take up the matter of a better rate, he will find a market for such concentrated products.

THE WEALTH OF MONTANA AS SHOWN BY STATISTICS.

By Morton J. Elrod, University of Montana.

Topography. The state has within its borders 9,491,200 acres of land. Of this amount about 26,000,000 acres are classed as mountain lands, 30,000,000 as farming lands, and 38,000,000 as grazing lands. This is approximately 40,000 square miles of mountains, 50,000 square miles of farming lands, and 56,000 square miles of grazing country. The mountain area of the state is about equal to the area of either Indiana, Kentucky, Virginia, Ohio, or Tennessee; its grazing land is more than the area of either Pennsylvania, Louisiana, Mississippi, or New York; its farming land is as much as the area of either Wisconsin, Iowa, Illinois or Michigan. The mountain area is largely in the western part. The main range of the Rocky mountains enters the state about a hundred miles east of the state line, and extends across the state from northwest to southeast, forming the boundary line between Montana and Idaho for several hundred miles—from 114 meridian to the Yellowstone Park. The crest of the range is quite tortuous, and contains many peaks. West of the main range of the Rockies are several smaller ranges. The Bitter Root mountains form a large part of the boundary between Montana and Idaho, from 48 parallel to juncture with the main range of the Rockies. The northern portion of the state west of the main range includes the Kootenais, which extend northward into the British Possessions. Between the Kootenais and the Bitter Root range are the Cabinet mountains, extending approximately southeast and northwest, continuing westward into Idaho. They form the western boundary of the Flathead Indian reservation, the lower summits blending with the Mission range near Misoula. The mission range extends almost due north and south for about a hundred miles, the northern end beginning in the valley at the upper end of Flathead lake,

rising higher and higher toward the south, culminating in McDonald Peak (9,800 ft.) Sinyaleamin Peak .9,500 ft.) and McLeod Peak (9,000). East of the Mission range lies the Swan range, extending almost parallel with the former, and continuing some 30 or 40 miles farther north. Like the Mission mountains the Swan range is highest at the southern end, culminating in Swan Peak (10,000). East of the main range are many smaller ranges, foothills leading from the Great Plains to the continental divide, with its high and snowy peaks. The Big Belt mountains form the boundary between Meagher county on the east side and Broadwater and Lewis and Clarke counties on the west. The range extends northwest and southeast for more than a hundred miles. In the southwest angle of the state, adjacent to the National Park, are many small ranges, including the Ruby mountains, the Tobacco-Root range, the Snow-Crest range, the Madison range, the South-Boulder range, the Gallatin range, Bridger mountains, and Snow mountains. Near the Wyoming line on the south is the small Bear-Tooth range, the Pryor mountains, the Rosebud range, with a high plateau in the southeast corner. The Little Belt mountains form a large portion of the boundary between Meagher county and Fergus and Cascade counties. Between this range and the Big Belts lie the small Dry Range and Elk mountains, while the Crazies are further to the southeast, and are the first high summits to greet the travlere on the Northern Pacific railroad as he speeds westward between Big Timber and Livingston.

Fergus county, in the central part of the state, is about as large as the state of Masachusetts. It contains the Big Snowy and Little Snowy ranges and the Moccasin mountains. North of the Missouri river the state is largely a great plain, broken by the Bear Paw range, culminating in Mt. Garfield (5,794 feet), and the Cherry-Patch hills at the northern boundary. The mountains contain many high peaks, the more lofty being in the Yellowstone Park region. Much of the mountainous region is yet unexplored save by the hardy trapper and prospector. The transcontinental railroads give the traveller a poor idea of the sublimity of the scenery which the many mountain ranges afford. Many of the snow clad peaks bear on their sides the remnants of glaciers, with miles of blue ice with huge crevasses, where the alpine climber may find untrodden and unnamed fields, where blue lakes reflect the azure depths of heaven, and where the bo-

tanist, the zoologist, the geologist, as well as the artist, may find a virgin field. Many of the peaks, lakes, glaciers and creeks are unnamed. Some of the more important summits, other than thos mentioned, are the following. Mt. Powell, Deer Lodge County, 12,000; Chief Mountain, 10,000; Mt. LoLo, Bitter Root range, 9,500; St. Mary, Bitter Root range, 9,500; Electric Peak, near the Park, 11,155; G. N., 10,000; Sheep Mountain, 10,628; Ward, 10,267; Pentagon, 9,400.

The greater portion of the state lies east of the Rockies. Most of this section may be classed with the Great Plains region, traversed as it is by the mighty Missouri and its tributaries. Part of this Great Plains portion of the state is high and rolling, eminently adapted for grazing; but a large portion is adapted to farming, when irrigated, and will supply homes and farms for thousands of families in the years to come.

River Systems.—The waters from the mountains of Montana are carried by different river systems to the three oceans, the Arctic, the Pacific, and the Atlantic through the Gulf of Mexico. In the western part the Bitter Root river gathers the waters from the snow crests of the Bitter Root range and from the spurs of the Rockies and unites with the Missoula near the city of Missoula. The Missoula river through its various tributaries gathers the water from a large portion of the western slope of the main range, including that which is used in the great smelters of Anaconda and which comes from the pumpings of the rich mines of Butte. Further north the North Fork, Middle Fork, and South Fork of Flathead River receive the drainage from the Mission and Swan Ranges, the west slope of the main range, and a part of the Kootenais. These unite to form the Flathead river, which first pours its waters into the greatest reservoir of the state, Flathead lake, and later joins the Missoula in the beautiful but narrow Paradise valley to form Clarke's Fork of the Columbia. The Kootenay river takes the drainage from the extreme northwestern corner, a part of the Columbia drainage system. The rivers on this western side are clear and swift, with rocky and picturesque canyons.

The Belly and St. Mary's rivers in the northern part of the main range carry the ice cold water from the glaciers of Chief mountain and the region adjacent on to the Arctic ocean. The sources of these two rivers are in the wildest and most picturesque portion of the state. If the plans of the National Gov-

ernment are executed much of the water from the St. Mary's will be diverted to the Milk river and used in the vast system of irrigation under contemplation. Mt. Stimpson (10,000) claims the proud distinction of sending its waters to three oceans.

By far the greater portion of the state is in the Missouri river drainage system. The Madison, Gallatin and Jefferson rivers gather the waters from the many small ranges adjacent to the Park and unite at Three Forks to form the Missouri. Near the city of Great Falls are the Falls of the Missouri, from which place the river is navigable to its juncture with the Mississippi. The Yellowstone river rises in Yellowstone lake in the Park, and after taking its two mighty leaps in the Park and flowing through its magnificent gorge it emerges as a restless river, continuing in swift descent until its waters merge with the muddy Missouri. The Yellowstone is the most rapid navigable stream in the world. From the north the Missouri receives the waters of the Marias, Teton, Sun and Milk rivers, all of which flow through valleys of great fertility. The scenery along the rivers is varied, and exhibits some striking antitheses. The valley of the Bitter Root is one of remarkable beauty. The river as it winds back and forth like a stream of silver, when viewed from Mt. Lo Lo, Ward's Peak, or St. Mary's in the Bitter Root range is probably equalled in quiet and peaceful grandeur only by the Yellowstone as it flows through Hayden Valley in the Park. The three branches of the Flathead present to the few travelers along their courses many gorges and canyons. The South Fork in one place in the Lewis and Clarke Forest Reserve has cut its way through solid rock, making a canyon so narrow that pack horses may be and are forced to leap from brink to brink, while the river seethes and boils many feet below, its ominous roar announcing certain death if the leap is short. The Missouri has made the famous "Gateway of the Mountains," its splendor first told by Lewis and Clark, and later made famous by the brush of artists. At the City of Great Falls it hastens its speed before tumbling over the beautiful Black Eagle Falls, spanned by a bridge on the Great Northern railway, and does not diminish its speed until the bottom of the Great Falls is reached.

The valleys of these rivers and their smaller tributaries make rich farming soil, suitable for grain, vegetables and fruit. The Bitter Root valley in the west was settled first, and is a great

farming and fruit raising region. The country adjacent to Flathead lake is thickly settled, and produces abundant harvest without irrigation. The Gallatin valley has become famous for its bountiful harvests, and the Yellowstone is being largely used for agriculture and fruit. The northern tributaries of the Missouri, while watering very fertile valleys, are in a thinly settled region.

Climate and Rainfall.—The climate of the state is exceedingly varied, and is much more salubrious than is generally supposed. West of the range the winters are mild, the summers and falls delightful. The rainfall at Misoula and Kalispell averages about 16 inches, while at Culbertson and Glendive in the eastern end of the rainfall is about 13 inches. Rain or snow prevails during the spring until early July. July, August and September are largely without rain, although in many places there is no need of irrigation. Owing to the different altitudes snow may fall later in the spring at some places than at others. An area of 30,700 square miles is below 3,000 feet elevation above the sea; this is equivalent to a state the size of Georgia. About 10,200 square miles exceed 8,000 feet altitude. The climate on the Pacific slope is milder and less changeable than that of the Atlantic side. The majority of the areas of high barometer, and accompanying cold, originate in the Arctic regions, and are deflected southward or eastward by the Rocky mountains. While eastern Montana and the Dakotas may be in the throes of a blizzard, the western end may be enjoying balmy weather. The coldest record at Missoula for 21 years is —22 degrees F, while in some winters the thermometer does not go below the zero point. The mean temperature at Missoula is 44 degrees F. At Helena, altitude 4,500, the mean temperature is 341. Chinook winds may occur over the entire state, melting large quantities of snow in a short period of time. Owing to the usual absence of a high percentage of humidity the cold weather is not extremely disagreeable, nor the warm days smotheringly oppressive. The hot days may blister the the skin, while the nights following will be cold enough to require blankets. Rarely does one sleep without considerable covering, and some people wear the same clothing summer and winter, donning extra coats or wraps in winter. This may be given as the general summary: the springs are rainy; the summers are clear and dry; the autumns are delightful; the winters are

clear and bracing. Owing to the absence of high humidity the climate is very beneficial to health, as statistics will show. It is especially beneficial to those affected with pulmonary diseases.

Agriculture and Husbandry.—In the early days of Montana's history it was not thought possible to grow crops in the state to much extent. Nearly everything was shipped in from the outside. As the mines developed the demand for food became so great as to stimulate agriculture. Fruit raising was also attempted. Marked success attended the efforts, and larger acreage of grain and orchards was put out annually, until agriculture and husbandry have developed into important economical features in the state's progres, and bid fair to rank close to the mineral wealth in the near future. In 1902 nearly a quarter of a million fruit trees were set out; the number was almost doubled the succeeding year. At the close of the year 1903, nearly one and a half million fruit trees had been set out in various parts of the state. The harvest in that year was a quarter of a million bushels of apples. The trees in the orchards include apples, cherries, plums, apricots, and peaches. Small fruit, such as gooseberries, strawberries, blackberries, currants, and the like, produce enormous crops from small acreage, while to describe the size and weight of the fruit is almost beyond belief. Apples are shipped to the eastern states and even to England. As they are remarkably free from insect pests, owing to stringent legislation and watchful care in orchard inspection, home grown apples are constantly in demand, the demand being far in excess of the supply. As a small part of the total number of trees bears fruit at the beginning of 1904, the insufficient supply is accounted for, but the crop of the orchards will increase in amount very rapidly. The Bitter Root valley, in the western part of the state on the Pacific slope, is the oldest orchard section, and is fast becoming famous as a fruit growing valley. But the orchards are not confined to this beautiful and fertile valley. The valley to the north of Flathead lake is filled with orchards already breaking beneath their loads of fruit. The Yellowstone valley is developing rapidly as a fruit growing region, even growing grapes. The most recent observations show that fruit trees may be grown and that apples will mature in every portion of the state, and apples are now grown in every county in the state with but a few exceptions. Horticulturists insist that fruit trees may be grown in every county in the state.

Since the portion of the state east of the Rocky mountains is much greater than that on the west the fruit growing possibilities of the state may be readily understood when it is known that the great majority of the fruit trees of the state are on the Pacific side.

The total value of farm property in 1900 was $117,859,823.00, an increase of 143.1 per cent in ten years; that of farms, including farm improvements and buildings, $36,513,750.00, an increase of 143.1 per cent in ten years; that of implements and machinery, $2,315,890.00, or 170.8 per cent; and that of live stock, $30,541,-146.00, or 141.3 per cent increase. The value of farm products for 1889 exceeds that reported for 1899 by $22,343,542.00, or 356.2 per cent increase. Of the total land area of the state 11,844,454 acres, or 12.7, per cent, were included in farms in 1900. The average size of the farms was 885.9 acres, of which 14.7 per cent was improved land. The total number of farms was 13,370, an increase of nearly 250 per cent in the decade. The total acreage in farms in 1900 was almost 85 times that reported in 1870. Eastern Montana contains more than three-fifths of the total area of the state. In the extreme eastern part lies the "Bad Lands," a continuation of the "Bad Lands" of the Dakotas, Wyoming and Nebraska, parctically non-irrigable because of its uneven surface. The Yellowstone valley has become famous for its growth of alfalfa, where two or three cuttings, a total of 4 to 6 tons per acre, are had. The Gallatin, Madison and Jefferson valleys in the southeast produce rich harvests of cereals, never failing through irrigation. In the west the Bitter Root, Missoula and Flathead valleys, while less extensive, produce as abundant harvests, often without irrigation. The lands are of three general classes—the bottom lands, near the streams, with rich, black, alluvial soil; the bench lands, whose soil is a sandy loam, capable of wide range of cultivation; and the high bluffs, suitable largely for grazing. Experiments in "dry land farming," farming on the uplands without irrigation, in 1903 indicate that good crops may be grown in this way, and the method is encouraged by the Experiment Station. 90.8 per cent of the farms are operated by the owners thereof. The entire Crow Indian reservation is included in the statistics as one farm, thus making the average size quite large. Nearly three hundred farms were operated by the Indians, twentysix by Chinese and twenty-one by negroes. This was about 0.4 per cent of the total

farm acreage. The government plans for irrigation will reclaim large tracts of land and put it under cultivation. The crops raised are corn (75,838 bushels); wheat (1,899,638 bushels); oats (4,746,231 bushels); barley (844,140 bushels); rye (32,120 bushels); hay and forage (1,059,361 tons); dry peas (32,265 bushels); potatoes (1,332,062 bushels in 1899); other crops in small quantity, making a total valuation of $1,692,515. During the past few years, many small fruit and truck farms have been started, promising greater returns per acre and greater variety of farm products, as ready market awaits all kinds of farm produce.

Montana leads the Union in the number of sheep, there being more than five million in 1902. The sheep industry has proven profitable in the eastern portion where there is much open range. Few herds are to be found west of the range. The fleeces weighed thirty-five and a half million pounds, valued at over six million dollars. In 1902 there were three-quarters of a million of cattle and one-fifth of a million of horses, the assessed valuation of the former being $3,121,000.00, and of the latter $3,900,000.00.

Timber and Lumber.—29 per cent of the total area of the state is covered with timber, which is 8 per cent less than for the average of the entire United States. The timber growth is largely of coniferous trees, yellow pine, tamarack, and Douglas spruce comprising the most of the commercial products. Along the streams occur forests of cottonwood. In the drier portions of the state stunted red cedars often grow along the smaller water courses, of great value to settlers, as they supply posts and wood. Forests of white cedar, or arbor-vitae, white pine and Engelmann's spruce occur in the western part. On the higher slopes and summits the alpine species thrive; but as they are limbed to the base of the tree and inaccessible they are not of value commercially. They are useful in preventing the rapid melting of snow in the spring, holding it until later in the season when it is needed in irrigation. A considerable portion of the state's timbered area is included in government forest reserves. On the west the Bitter Root reserve includes a portion of the Bitter Root range within the state, and since the higher summits are not in the water shed of the range, but far to the east of it, the reserve includes territory from which comes the water to irrigate the fertile Bitter Root valley. In the north is

the Lewis and Clarke reserve, formed by the union of the original Lewis and Clarke reserve, the Flathead reserve, and a narrow strip along the Great Northern Railway which was originally not included in either. In the southeastern part is the Gallatin reserve. In 1902, the same year in which the proclamation was made for the Gallatin reserve, proclamations were issued setting aside the Little Belt Mountain reserve, the Madison and the Absaroka reserves. The area embraced in each is as follows:

1. Lewis and Clarke, 6,732 square miles, or 4,308,480 acres, not including the narrow strip along the Great Northern railway. 2. The Bitter Root, 6,480 square miles, 450,000 acres of which are in Montana, the remainder in Idaho. 3. The Gallatin, 63 square miles, or 40,320 acres. 4. The Little Belt, 503,040 acres, including the town of Neihart and the Yogo sapphire mine. 5. The Madison, 800,000 acres. 6. The Absaroka, 1,385,000 acres. The total of all land in government forest reserves in the state in 1902 was 7,487,400 acres, nearly 11,700 square miles, or about one-thirteenth of the total land area of the state.

The total output of the lumber mills in 1902 was 210,047,000 feet of rough lumber, 5,500,000 shingles, and 17,000,000 lath. The United States Geological Survey in 1902 estimated all of the merchantable timber on all of the reserves in the state at 14,974,800,000 feet. On state land there was estimated to be 912,000,000 feet, making the total estimate of merchantable timber on state or government land 15,886,800,000 feet. This estimate does not include timber in the Northern Pacific land grant, nor on the land belonging to private owners and milling companies. At the present rate of consumption the timber on state and government land would satisfy the mills as running in 1902 for about 70 years.

Mines and Mining.—Montana has been known principally on acount of her mines, and leads in the production of copper and in the output of sapphires. The early history of the states is the search for gold, and many of her towns and cities are built in gulches where placer gold was mined. Virginia City and Helena are illustrations, the former being the oldest mining camp in the state. Although Butte is the greatest mining camp in the state, and, indeed, the greatest in the world, it is by no means the only place where mining is carried on. In 1900 mining for gold and silver was carried on in the following counties: Beaver-

head, Broadwater, Cascade, Chouteau, Custer, Deer Lodge, Fergus, Flathead, Granite, Jefferson, Lewis and Clarke, Madison, Meagher, Missoula, Park, Ravalli and Silver Bow. Lewis and Clarke was the greatest producer, with 70,000 fine ounces of gold and 172,531 fine ounces of silver. The total product of gold and silver in the state in 1900 was 229,114 ounces of the former and 14,294,835 of the latter. In 1901, there were 232,331 ounces of gold and 14,180,545 ounces of silver. During the forty years following the discovery of gold in the state over one billion dollars in value of gold, silver, copper and lead have been taken from the streams and mountains of the state. While Butte is the mining camp for copper, it is also mined in the counties of Beaerhead, Granite, Jefferson, Lewis and Clarke, Madison and Meagher. Butte, in Silver Bow County, produced 227,742,262 pounds of the total of 228,031,503 pounds from the state in 1901. Lead was produced in all the counties mentioned except Madison, and in addition also in Broadwaater, Cascade and Flathead. The total lead output in that year was more than eleven and a half million pounds, and in 1902 it was nearly sixteen million.

Montana is one of the richest coal states in the west, although much of it is undeveloped. Two million tons were mined in 1902, and new mines are being opened annually. The Cretaceous bituminous and semi-bituminous coal areas in the state cover about 13,000 square miles, and the lignite area about 25,000. Not all of this territory contains coal, of course, but the deposits are found quite abundantly throughout the territory. The tests show the bituminous coal to be but little inferior to Pennsylvania bituminous coals. Bituminous coal or lignite has been found in every county of the state except Jefferson. The undeveloped coal industry will without doubt be a prominent factor in the future expansion of other industries of the state. In addition to its coal the state has extensive beds of clay; the brick and clay product in 1902 amounted to a half million dollars. The output of building stone was about the same.

Montana leads the Union in the production of sapphires, the actual mining of which began in 1891. Four mining regions may be mentioned: A belt 12 miles northeast of Helena on the Missouri river; the Rock creek region 30 miles west of Anaconda; the Cottonwood creek field 10 miles east of Deer Lodge, and the Yogo mines in Fergus county, 13 miles west of Utica. The annual output of sapphires in the state in 1902 was between 450,000

and 500,000 karats, including those suitable for cutting and those used for mechanical purposes. A lapidary at Helena employed 15 men, and it is asserted that finer work is done there than on stones sent to London.

Manufactures.—The predominating industry is the smelting of ores. The largest smelter in the world, the Washoe, is located at Anaconda. For the treatment of ores water is brought from a lake some 15 miles away in the mountains. The smelters of Butte have long been known. At Helena a large smelter is in operation, and another at Great Falls, where water power from the Missouri river is used. Many flouring mills have been established, utilizing almost the entire crop of wheat in the state, and consuming large quantities from the Dakotas. The large lumber mills at Bonner, Hamilton, Somers, and other places have extensive factories in connection with the saw mills. They manufacture doors, sash, blinds and other finishing stuffs. They also make large quantities of furniture from native lumber. A woolen mill, in operation in Big Timber, established in 1901, consumes a considerable amount of the wool product. Although Montana leads all other states in the number of sheep, the loss from the two items of freight eastward, and the difference in the value of the wool in the grease and the scoured product, will annihilate the value of all the flocks on the range of the state in 10 years, 7 months and 9 days, if the wool is all shipped to the east. To treat it in the state will save $1,000,000 annually to the state. Nearly every large town has a factory for malt liquors. Creameries and butter factories are springing up. The transcontinental railways have several repair shops and round houses in the state. A biscuit and cracker factory is located at Helena and does a large business. In 1900 1,000 establisments, representing a capital of $40,945,846, were operating in manufactures and mechanical industries. The value of the product, $57,075,824, involved an outlay of $837,971 for salaries of officials, clerks, etc., $7,969,886 for wages, $1,668,487 for miscellaneous expense, and $31,702,650 for materials, freight and fuel. The value of manufactured products in ten years from 1890 to 1900 increased ten fold, or more than 1,000 per cent and more than thirty times the value in 1870.

Railroads.—The total mileage of railroads in 1902 was 3,131.87 miles, with 572.14 miles of side track. During that year and the year preceding 199.5 miles of road were constructed, not

including large expenditures for betterment of track on existing road. Two transcontinental lines cross the state. In the north is the Great Northern, with its many branch lines. Toward the southern part is the Northern Pacific, also with numerous short branch lines as feeders. The Burlington connects with the latter at Billings, running through trains over the N. P. tracks to the coast. The N. P. operates three daily passenger trains each way over most of the state—as far east as Billings, where one takes the Burlington route for Denver, Omaha and St. Louis. The Great Northern operates two daily passenger trains each way over its road. The Oregon Short Line connects at Butte, making a gateway to Salt Lake and the south, east and west. From one end of the state to the other on the Northern Pacific requires about 24 hours of travel, following for considerable distances the Missoula, Missouri, Gallatin and Yellowstone rivers, with their varied scenery. The Great Northern skirts the banks of the Kootenay, the Flathead, the Milk, and the Missouri rivers, and gives a view of the great unoccupied field along the two latter.

Finances.—The total assessed valuation of all property in the state in 1902 was $183,395,690. The constitution of the state prohibits an indebtedness exceeding $100,000. The tax rate was less than $2.50 per $1,000.

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